Enrique Castaño Perea
Ernesto Echeverría Valiente *Editors*

Architectural Draughtsmanship

From Analog to Digital Narratives

Springer

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Enrique Castaño Perea · Ernesto Echeverría Valiente
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Preface

The book presented here is a compilation of articles collected under the title*Architectural Draughtsmanship: EGA (Architectural Graphic Expression) From Analog to Digital Narratives*. It is the result of the International Congress EGA (Architectual Graphic Expression)16 held in Alcala de Henares in June 2016 with the subheading: "Teaching and researching in architectural graphic expression."

This was the 16th edition of the Congress, and it was again centered on the exchange of knowledge of what is taking place within the arena of architectural graphic expression inside and outside of our country.

The implementation of a successive curriculum over a short period of time (BA in Architecture, BA in Fundamentals of Architecture, Master of Architecture and Ph.D.) has led to the necessity of restructuring all areas of study within this field, and for that reason, it seemed the right moment to turn our attention to the work of professors and researchers. As the last Doctor Honoris Causa of the University of Alcala Kenneth Frampton said in his acceptance speech, we have to reclaim innovation by starting from tradition, both in terms of architecture and educational disciplines attached to it.

This book is organized into two major parts:

A/ Research into the field of architectural graphic expression, including related areas of education, in which innovative experiences have been presented in the new curricula,

B/ and how to teach research methods that are essential to the work and experiences found in the field of postgraduate studies.

The editors have grouped the articles into four major chapters, according to their individual subjects:

1. Innovation Teaching Strategies (Teaching experiences applied in EGA).
2. Design and Education (General education concepts in EGA).
3. Design and Architecture (Design issues related to current architectural practice).
4. History and Cultural Heritage (History of a particular designs and/or the design's application within the architectural heritage).

Blind pairs reviewed all articles as a guarantee of quality in order to obtain the recognition of the scientific community.

All the works are in English, although they may have originally been written in one of the languages of the Congress, either Spanish, Italian, or Portuguese, with the goal of emphasizing their respective international characters.

We believe this compilation of articles could be the trigger to start a new collection of books about the international relevance of architectural graphic expression. It is the result of the important contributions taken from the congresses dedicated to the subject that have been held regularly for over thirty years, with the participation of a large number of researchers from European and Latin-American countries.

Alcalá de Henares, Spain

Enrique Castaño Perea
Ernesto Echeverría Valiente

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Part I
Innovation Teaching Strategies

Towards a New Descriptive Geometry. A Teaching Innovation Project to the Architecture

Antonio Álvaro Tordesillas, Noelia Galván Desvaux and Marta Alonso Rodríguez

Abstract The last two courses we have introduced in the subject of Descriptive Geometry at the School of Architecture of Valladolid, several changes by a Teaching Innovation Project able to solve some of their deficiencies and to update the subject with three objectives: to involve students in a dynamic way, introduce materials based on new technologies and bring the program to the actual architecture and new tools projection instruments. The present text attempts to explain the methodology and achievement of these goals; and share the experience of two exercises based on techniques such as gaming and cooperatives Aronson's puzzle, which have been widely accepted and have had excellent results in academic and pedagogical terms.

Keywords Educational innovation · Descriptive geometry · Aronson's puzzle

1 The Need for Renewal. State of the Question

The continuous changes in the curriculum that we have been suffering in recent years in studies of Architecture at the School of Valladolid, promoted, to some extent, by the ghost of a the Bologna Plan which was never implanted as it should, have meant that the subject Descriptive Geometry has suffered a number of several transformations. But while the environment was unflattering, we have tried to convert under the difficulty by proposing an update of the course, away from a corseted adaptation by credits, hours and semesters.

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The first difficulty was the gradual reduction of hours/credits for the graphic first year courses, including Descriptive Geometry. This reduction had meant until now the immediate decline of the subject matter, but never a remodel, reconsideration or update.

In addition, an annual course has been divided into two half with a significant difference of credits: three for the first half and six for the latter. Which is a real challenge when it comes to spinning a continuous development of the subject. Continuous development not only in a successive and chained syllabus, but also in a teaching method that precise time of a complete course to develop properly.

A second difficulty was almost endemic feet for over twenty-five years the course was taught in the same way. The reasons go beyond mere comfort and little connection by teachers who seem the simplest; although this is not subject matter of this paper, we can suggest some others. The first and foremost is the high number of students from groups that exceeded forty. So numerous groups do not allow the teacher take the time to each of them properly. So numerous groups predispose to lectures where communication is unidirectional.

Another important reason is the conjunction of two realities that are being progressively detected in the pupils. On the one hand, comes with a low self-critical level of secondary education brings. Any result is worth, and rarely questioned whether it is enough or could have been done better. It complies with being mediocre. “Being incapable of enthusiasm is a sign of mediocrity” (René Descartes). Mediocrity around us and beyond our competence matter as teachers, but that check is firmly entrenched in our society. Though not exclusive of our time.

Furthermore, the heterogeneous degree of knowledge with which they start the course. You cannot start a course of a few weeks spending two or three to go over knowledge that would have assumed known.

2 Developing a Teaching Innovation Project. Goals

Aware of these problems, two years ago proposed a Teaching Innovation Project (TIP) that face them and update the course with three clear objectives: to involve students in a dynamic way, introducing materials and tools based on new technologies and redirect the course syllabus, more pragmatic and immediate contact with real architecture. These objectives are in themselves sufficient to assess the proposal in terms of educational innovation and measure their validity and suitability.

The three also are so closely related that support each other. An overly complex subject frightens the student. Student involvement would be unstoppable if they had tools that will bring them to see and understand that space, if their connection with the subject, the teacher, the content and the rest of their peers not only be limited to school hours but could expand with the application of virtual desktops—moodle—as well as if that abstraction of the geometry came near the built architecture.

It must be noted that this has been possible thanks to the convening that the University of Valladolid conducted to optimize the teaching practice and the incorporation of innovations that improve it. In our case this meant we could reduce the number of students per group and the Centre acquired a tactile whiteboard accurate enough to draw on it and projecting three-dimensional models of objects and spaces that would develop in class.

3 Involve Students

The first objective is to involve the student with the subject, as we have seen, for what needed to be done revitalize the teaching. This is achieved by driving the student to participate in the drafting and implementation of team exercises, as well as the presentation of teaching material. This requires a communication teacher-student and student-student almost permanent and easy, for what platform moodle connection was introduced; where to host the syllabus of the course, exercises, and provide a forum in which keep in touch (Calleja González et al. 2009).

One consequence of this new responsibility of the student, in his role as partner-teacher, is that it allows him to keep up; with the advantages that this implies in the progression of the course that builds on previous concepts, and what to say against a final evaluation; this other aspect to revolutionize. Another consequence is the stimulation that this represents for cooperative teamwork, giving students some skills before not even raised.

4 New Technologies into the Classroom

The second objective involves the introduction of new materials and technologies in the classroom and on the way to deal with spatial problems of this subject.

Today teaching descriptive geometry is possible from the analysis of figures in space. Their relationships, positions, proportions, etc. can be seen directly into a three-dimensional model. Easy to navigate, easy to understand and easy to build. It makes no sense to continue exclusively with teaching models anchored in the rigidity of the projection systems, when we can directly see everything in 3D and build, think three-dimensional geometry.

We have introduced tools able to help us and encourage us in thinking and development of three-dimensional figures in space, fundamental in our area of knowledge.[1] Visualize in real time and in three dimensions, which until now was forced to draw in two. To work environments with computer aided design allows us

[1]The software that gives us better results today is SketchUp, because it allows us to model a volume, surface, etc. directly in 3D, regardless of their characteristics dihedral projections. Also, without the necessity of a previous course to learn how to handle it, for its fabulous simplicity.

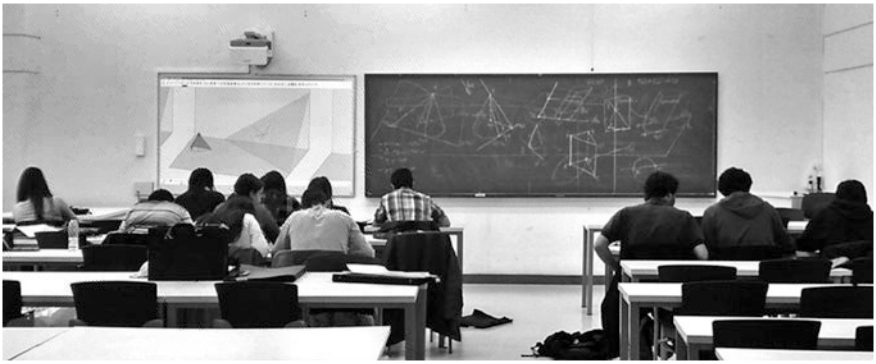

Fig. 1 GD classroom. The digital and chalk blackboards perfectly complement classroom

to influence important aspects of geometries that are studied. Obviously, without neglecting adequate representation systems that the novice student can easily forget against the excessive adoration of the computer as a drawing tool.

Needless to say that the special operations that until now we were hoping to spatial vision, in procurement process, and its two-dimensional representation, arise spontaneously in three-dimensional virtual space and the student learns and apprehends intuitively. Being able to navigate around them the spatial thinking approaches almost a promenade architecturale (Figs. 1 and 2).

We also have whiteboards that allows the teacher to manipulate the objects with his hands. Orbiting about a piece with a hand motion, drawing a section with the fingers, make the students to be introduced fully into the matter. Understanding is much more immediate and its assimilation rapid and effective.

Having tested and verified results this year, we thought it would be appropriate to introduce equipment that would build models designed virtually. As the tentative agreement/contract with specialized companies for construction and sponsorship of pieces designed in the classroom by the students.

5 New Course Syllabus

The redirection of the subject is not understood if is not accompanied by the above two objectives. As for the program is concerned, this is materialized in two ideas: (a) focus on the topics to be studied to pragmatic aspects, and (b) enable students to develop sufficient skills to a three-dimensional thinking.

The first idea refers to introduce new aspects of the subject with immediate applications, bringing in a natural way the geometry of the tangible architecture. Not only to work with real models, real buildings, but incorporating materials and practices that enable their ability to think in three-dimensional space. This means saving an initial obstacle, as is the ability to view from any perspective and to

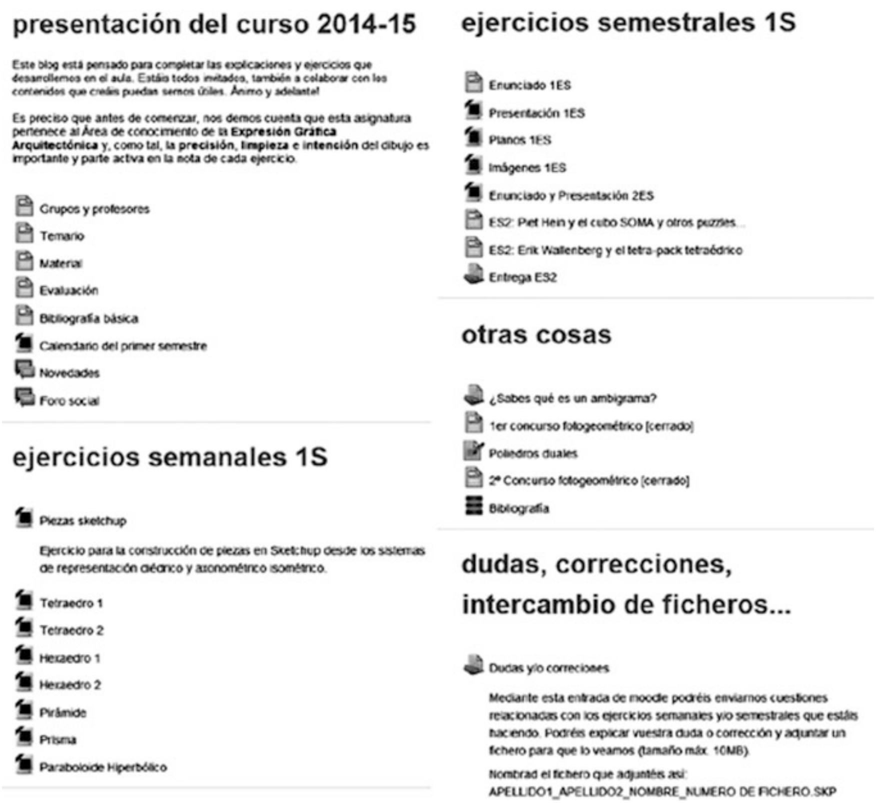

Fig. 2 Moodle diagram a course of descriptive geometry

imagine the operations on the model are raised in situ; that far from meaning a relaxation in the learning of the spatial vision is a support that enables to make it more easily and quickly.

In the second, we are qualified since the moment that we can introduce in the classroom technologies that allow us to work directly with virtual three-dimensional models, and not just with their projections on any known projection systems. Work in space allows us to go faster on some issues: the intersection of figures in space, or the calculation of shadows, must be redirected at the stunning speed, immediacy and simplicity of virtual models provided by the computer. Another clear case arises when refocusing the conical projection system. The short time that we have cannot be lost in the manual calculation of myriad lines that correspond homologously with a view, to take an example. The decision making in establishing criteria in choosing a reference system capable of displaying what each student intends, with a clear intention, not dictated by the teacher. The speed saved in this particular case, can go a step further, something that had never been done in our school; and it is to flip the projection system and use it for rectification of perspectives, this is photographs. So we introduce into the program a fundamental issue for an architect such as photogrammetry.

Within this objective, and in relation to the new orientation of the course syllabusit is necessary that definitively eliminate the classic evaluation system by examination. Procedure that has been seen since the introduction of the Bologna Process progressively modified, giving less and less importance to this test in favor of other tutored classroom practices and those made at home, individually or in groups.

So, we are testing a continuous evaluation where those practices are multiplied along the course and allow students to gradually and progressively overcome syllabus. Obviously the tests were of various types, from the work done in house, group work in class, oral presentation of the syllabus, the proposed exercises to their peers. Continued attention to the work and results of each student have to be sufficient to evaluate it, so even that such evaluation could be constantly encouraged towards a continuous improvement. Among the tests that we have developed in class, two are worth developing, by the way they push students a positive manner. The first is to expose part of the syllabus rather than the teacher. The method known as puzzle Aronson (Aronson et al. 1978) is a tool that impacts on increasing the skills of students in addition to their expertise in a particular topic, through a dynamic and functional methodology (Martínez and Gómez 2010).

The second is the implementation of a new method described as gamificación (Smith 2011). The incorporation of game mechanics, to the learning of descriptive geometry has allowed us to experience and then to see how the students live a serie of experiences that enrich their learning, giving it major attraction and motivation. This is achieved through the attainment of goals, recognized by the community, that is, both teacher and peers (KAPP 2012).

6 Two Exercises Performed in Class

We want to share the experience of a couple of exercises performed in two consecutive courses that have been widely accepted and have had excellent results in academic and pedagogical terms. We believe this because through these exercises, the students have been in the situation of thinking directly in space, with a specific goal, not only to solve abstract problems and/or transfer sequences memorized. It was to provide a practical dimension to an essential material for the development of architecture, as we have said, but of great abstraction and complexity for students.

The first exercise was to imagine, draw and build one or two pieces that repeated and/or linked together would form cardboard furniture. It was necessary start from any polyhedron modified by any spatial transformation that turned it into so unique and special one.

The student must behold through game-based learning in teams, a set of five stages or levels that provide recognition in overcoming some milestones: the multifaceted design of the prototype, its dihedral description, the digital three-dimensional modeling, the prototype development model and its real size physical construction. The scope of these levels meant one of the strongest motivations for students-players. At the same time, it was possible to draw a leaderboard where graphically appreciate the evolution and position of each group in the development of game-exercise. While some levels were achievable in almost immediately, others needed a dedicated teamwork. The competition between them was a motivating element by itself; the competitive environment in which we set concluded with getting higher levels of performance because it has been shown how a degree of student satisfaction is achieved by comparing one's own performance with that of the others.

The theoretical development prior to the exercise went through the study of the filling of space by rectangular matrix or non-periodic matrix. Jumping from 2D to 3D allowed us to move in different ways to fill the space that allows the association of polyhedra as hexahedron, octahedron or dodecahedron truncated. Either by collecting various polyhedra allowing studying spatial meshes. The student, in his eagerness to quickly overcome the level and with the highest score possible, sought and analyzed several previous studies on the topic. Our job as teachers was to guide their proposals. We were interested in pieces designed by Abeille or Truchet and Frezier, in generating surprising 'self-supporting' surfaces. We look at the prototypes of Anne Tyng, the marriage Eames, in Pérez Piñero or Buckminster Fuller, etc. (Fig. 3).

Fig. 3 Exhibition of works at the School of Architecture and students working in class, 2014

Fig. 4 Exhibition of works in the School of Architecture, 2015

Then analyze the way nowadays is used the geometry is used for the realization of furniture, both for everyday use, as unique design. The combination of recyclable materials and low cost has meant a boom in this type of design, so it seemed an ideal way into the commitment to involve students in the field. And we are particularly interested in that furniture designed by architects, which linked us closer to reality.

Although the material was imposed in the title of the exercise, the experimentation that about the material has been performed along the story was not only conceptually alien to the work but enriching in the way of generating the pieces and how conditioned its geometry.

The last level of the game was also the award because the works that completed all previous levels were built to actual size. The way of working was different now, because the groups had to be remodeled by the designer of each of the selected pieces. In the process we had to rethink and modify some parts of the prototypes to finally exhibit in a temporary exhibition that was installed at the School of Architecture of Valladolid[2] (Fig. 4).

The current course have developed an exercise based on the same methodology, but through a different geometric operation, the folding, and designing different objects: a tent or mobile cardboard cover, freestanding and ease of assembly, disassembly and transport.

The wrinkles or folded structures are broken surfaces formed by sheets having space charge capacity (Angerer 1964). The aim of the exercise was to make

[2]After exposure, it was called the first contest of cardboard furniture for all students in our school, all courses, sponsored by the Valladolid's cardboard factory San Cayetano.

students reflect on the creative capacity that is able to achieve by folding paper, and possible architectural spaces that can generate.

The development of the exercise has followed the methodology tested last year; with its same five phases and milestones overcome. The theoretical development, while sharing much of which is generic in the syllabus of the subject, obviously has a specific section devoted to the study and analysis of the folding; both as geometric operation, and investigation of the already existing architectural applications. From simple cardboard shelters for victims of natural disasters to deck spaces as the marquee of the racetrack in Madrid or the Labour University of Tarragona; or conceptual spaces of Zaha Hadid for the Venice Biennale 2012.

7 Conclusions

The overall feeling of the project is very positive. The three stated objectives have been achieved. We were able to actually see how the students learned the subject feeling complicit in their teaching. The student-teacher roles, still exist; but have been diluted to the point that they sometimes directed learning. The subject that emerges is much stronger, solid, pedagogical, than the one we had been practicing in recent years. And this is without great modifications in the syllabus, but for how changes in methodology, changes in instrumentation, etc. have elevated it to a higher level. And this is corroborated by the results, mainly on the participation of students and academic results obtained compared with those of previous years. Data corroborated by the students themselves through two surveys conducted over the course, where they could criticize in a very positive way, the processes, methods and course content.

The experience has been very positive, but this has required an outstanding job in its conception, preparation and implementation throughout the course. This methodology involves the students but also the teacher. And forces him to be aware of the students seven days a week for a full year. It forces him to 'dig' in his baggage for ideas and exercises to encourage his students to help them understand the subject and the reason for their study, and bringing them closer to a method of study, close to the research.

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Marta Alonso Rodríguez Doctor Architect by ETSA at the University of Valladolid (2013) and associate professor in the Department of Architectural Graphic Expression at the same University since that year. She is professor of Descriptive Geometry and BIM. Her doctoral thesis entitled Oviedo Forma Urbis, focused on the use of new technologies to reconstruct the urban heritage disappeared from the city of Oviedo. Her work developed on this line, has centered on the Implementation of new information technology for the restitution and diffusion of architectural heritage.

Systems of Representation. A Space for Constructing Knowledge

Leandro Madrazo

Abstract Systems of Representation (in Spanish, SDR—Sistemas de Representación) is an open learning space that fosters the creation of links between different subjects: art and architecture, graphic design and visual communication, visual studies and representation. In this space, learning is the result of building relations between the different subject-matters in multiple ways. Teachers become designers and facilitators of the learning processes which students develop according to their own skills and interests. These learning processes exemplify a design thinking by which knowledge is acquired without adhering to established methods. Teachers and students contribute to creating the learning resources through the web-based learning environment SDR: NET. The adopted blended-learning model integrates the activities that are carried out in the classroom and in the web environment.

1 Introduction

Systems of Representation (in Spanish, *Sistemas de Representación* or SDR)[1] is a subject that forms part of the study program of the School of Architecture La Salle since the academic year 1999-2000 (Madrazo 2000). The pedagogical approach – which is in line with the preliminary courses of the Bauhaus and Vkhutemas schools—and the structure of the course—organized into six themes: Text, Figure, Image, Object, Space and Light—have pervaded over the last fifteen years in which the course has been taught, even though the contents as well as the learning methods and tools have changed in this time.

[1]http://www.salleurl.edu/sdr.

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2 Preliminary Basic Courses

In the early twentieth century, the Bauhaus (Wick 2000) and Vkhutemas (Khan-Magomedov 1990) schools established the preliminary basic courses of their respective curricula which would later become a pedagogic model for other schools of architecture and design. The sense of these courses was mainly propaedeutic. As Johannes Itten contended, a "basic course" (*Vorkurs*) was neither a specific subject nor a teaching method (Itten [1964] 1967, 9). Its aim was to develop the students' creativity by experimenting with basic concepts such as rhythm, form, space, colour, texture and material; elements that were considered objects of study in themselves. In the period immediately after the end of World War II, the basic course model was spread to other schools including the New Bauhaus in Chicago, the Hochschule für Gestaltung in Ulm and the teaching of the Texas Rangers in Austin. Akin to this pedagogic line were the courses on visual language taught by György Kepes, first at the New Bauhaus led by László Moholy-Nagy, and later at MIT (Wallschlaeger and Busic-Snyder 1992). During the 1960s, interest for these courses in architecture schools fell, although it did rise again later (Boucharenc 2008). According to Sausmarez, the objective of this basic training is "to develop personal enquiry on the basis of practice, not theory, seeking always the individual solution to each problem" and placing the emphasis on "intuitive and analytical work with materials and formative principles" (Sausmarez 1964, 10). In this way, the basic courses aim to develop an "attitude of mind" rather than facilitating a "method"; they are a "form of inquiry" rather than an "art form"; they are concerned with form "in a fundamental sense in every field" and they incite curiosity about "the external world or the interior world of visions, personal reactions and preferences" (Sausmarez 1964, 11–12).

SDR shares these objectives of the basic courses while it seeks to expand their realm—which tends to be confined to the visual study of form, space, colour and materials—to include other topics related to graphic design and typography, with communication and image technologies (film, video, photography). Likewise, SDR promotes the combined use of digital tools—word processing, design and layout, drawing and modelling, renderings, image processing and animation—with other techniques considered traditional—writing, drawing, physical models, and photographs–.

3 Multidisciplinary, Interdisciplinary, Transdisciplinary

SDR is a learning space in which knowledge is constructed by interlinking different subject-matters: art and architecture, aesthetics and composition, graphic design and visual communication, visual studies and representation (Fig. 1). The multiple relationships between these subjects result in a space of knowledge that transcends the boundaries of each individual matter. In this open and multidisciplinary learning

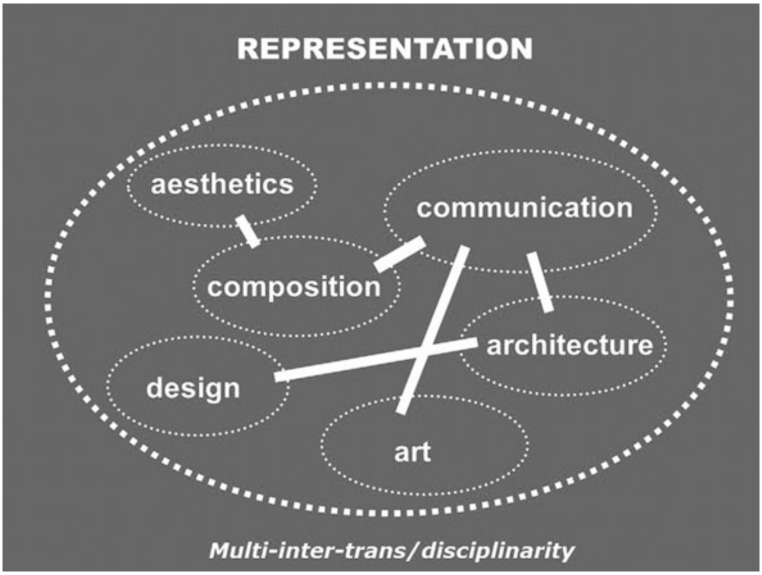

Fig. 1 SDR: a space for the construction of transdisciplinary knowledge

space, the collaborative construction by teachers and students of relationships among the different areas of knowledge becomes a key objective of the course.

As a result of the industrial revolution and technological progress, knowledge became segregated into disciplines, that is to say, it became "scientified" (Thompson 1990). Consequently, knowledge could then be characterized as "multidisciplinary" and the unity of knowledge lost as a result of the "scientification" would be the result of bringing together various disciplines. "Interdisciplinary" knowledge would be the result of intertwining different fields within a particular context, for example, around a design problem. Finally, "transdisciplinary" knowledge would be that which transcends the scope of the interrelated disciplines, a knowledge that would become subsumed under a new conceptual framework—transversal and hybrid—which cannot be identified with a specific field and for which it is difficult to find a name. Precisely, what "SDR"—the name we gave to this transdisciplinary knowledge area– promotes is the creation of productive relationships between different subjects in order to create a new conceptual framework resulting from their integration in a given context, namely, around a design task.

Some of the subjects that are integrated in SDR are dealt with in other courses of the curriculum, such as Graphic Expression, Descriptive Geometry, Computer Tools, History and Composition. With regard to these courses, SDR offers an opportunity to apply the knowledge that students have acquired in a learning space that is built from a network of relationships between different subjects. In turn, SDR contributes to building bridges different areas across the architecture curriculum, rather than trying to "restructure" them.[2] However, in the activities carried out in the course, the knowledge derived from a particular subject is not just instrumentalized (as might be the case when we turn to a specialist to make a structural calculation of a building, for example). Neither is the goal of the course to blend various subjects in a common structure. Rather, it is about bringing out a transdisciplinary framework that supersedes individual subjects while respecting the specificities of each course and knowledge domain (Thompson 1990). These relationships between courses and subjects are set out in various ways. In the classroom, contents are exposed in a relational way, linking some topics with others. Accordingly, colour theory is explained in relation to composition and computer graphics; visual composition is related to musical composition, and concrete art painting to Gestalt psychology. This relational thinking is also applied by the students in the learning activities that they carry out. For example, the creation of a computer animation reflecting the visual interpretation of a concrete art work and its relationship to a musical composition.

4 The Concept of Representation

In SDR, the notion of "representation" alludes to the conceptual framework that transcends the subjects that become interrelated in learning and teaching. Commonly, representation refers to what is opposed to the reality of an object, such as an image of something. In a Kantian sense, representation can be considered as a conceptual structure that mediates between the subject and the object and makes reality intelligible. Considered in this way, as a mediation structure, representation is as real as reality itself.[3]

The congruence between idea and representation is a central theme of the course. This correspondence is revealed when an idea is expressed through various representations. If the idea and its representation are one, a change in the representation necessarily leads to reconsider the idea in itself. In the learning activities, this translation process between different representations is exercised in various ways: for example, representing ideas derived from reading a text about architectural theory in a multimedia work or creating a digital model from an object previously built with a certain material and technique.

From an epistemological point of view, the notion of representation refers to the cognitive structures that lie behind the creative process. In this regard, SDR promotes *design thinking* as a way of reaching knowledge through ways different to

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[2]In the 1970s, the British Group of Research and Innovation in Higher Education made a distinction between two types of interdisciplinarity. "Bridge building" takes place when a relation is established between two consolidated disciplines; "restructuring" involves introducing structural changes into the disciplines in question (see Thompson 1990, 27).

[3]This notion of representation—as a conceptual structure which mediates between the subject and the object, acting as an autonomous reality—was postulated by Kant (*Vorstellung*) and Popper (the "third world" constituted of conceptual structures).

those followed by the sciences and humanities; ways to which Nigel Cross referred to as "designerly ways of knowing" (Cross 2007). Accordingly, the goal of a design-based education is to acquire knowledge without following guidelines or established patterns, being aware of what one is learning and how it is learned (self-reflection) (Cross 2007, 20). Thinking in terms of design involves defining a problem and providing a solution to it with the means and resources available; it entails developing a constructive thinking based on abduction, rather than on induction and deduction (Cross 2007).

5 Learning Design

The pedagogy of the basic courses and design thinking coincide in some of their objectives with those of the constructivist philosophy of education. According to Jonnasen (1994), in a constructivist learning environment—unlike in an objectivist one, dedicated to imparting a knowledge which already exists—students construct their own reality from their experience, that is, from their own mental structures and convictions. In constructivist pedagogy, the role of teachers is to design learning environments that help students to develop their own capacities, rather than to provide them with methods to acquire a previously systematized knowledge. Unlike objectivist learning, constructivism looks at the processes rather than at the objects of knowledge (Jonassen 1994).

SDR is akin to this constructivist approach that places the student at the centre of learning (*student-centred teaching and learning*). Therefore, our pedagogic work is largely dedicated to the design of the learning environments in which students will develop their knowledge—construction processes (*learning design*). In the design of the learning activities we take into account the processes, materials and resources required to achieve the learning outcomes. These activities are structured in sequences (*learning sequences*) and are carried out individually and in collaboration. Along these sequences, the outcome of a learning activity might become the starting point of the next one. This may imply, for example, the translation (transposition or transference) of an idea from a system of representation to another: translating a text to a multimedia presentation; a physical model to a digital one—or vice versa–; a photograph to a narrative; or the experience of a space in a space represented in a video. In this way, the sequences of activities connected to each other facilitate a learning process that each student adapts to his or her interests and capabilities.

6 Collaborative Learning Environment

The constructivist learning environment fostered by SDR encompasses classroom sessions—mainly dedicated to exposing the topics to reflect upon, explaining ideas and concepts and discussing them with the students—and the work done on the

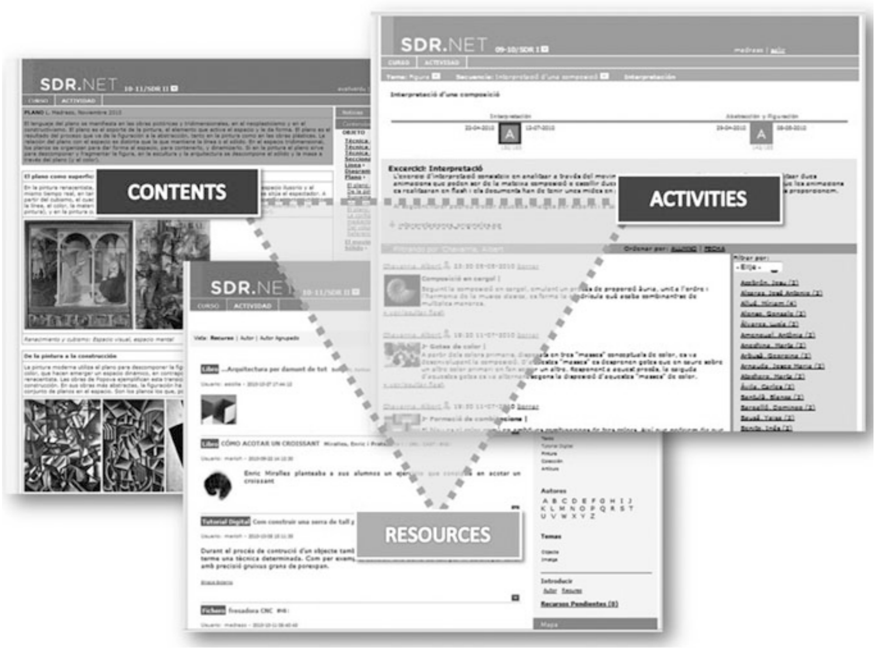

Fig. 2 SDR: NET. Integration of theoretical contents, learning activities and resources to perform them

on-line environment SDR: NET that has specifically been created for this course. In order to make this *blended learning* model effective, it is essential to create pedagogically meaningful links between the on-site and on-line activities. Precisely, one of the purposes of SDR: NET is to facilitate the creation of such links.

With SDR: NET, teachers—acting as *learning designers*—create the sequences of learning activities and connect them to the resources (readings, references) that students need for carrying out their work (Fig. 2). Through SDR: NET, students' works are available for the whole class. In this way, students contribute to creating educational resources to be used for new learning activities (*resource-based learning*). For example, to evaluate and comment on the work of other students; to create relationships between different students' works; or to group those that have some features in common. Works created by students are also related to the resources provided by teachers, thus facilitating the collective construction of a relational knowledge in which students and teachers participate. As a matter of fact, SDR: NET exemplifies what Punie (2007) has called *learning space*, an immaterial space that goes beyond the classroom, where processes of knowledge construction are carried out with the participation of learners (teachers and students).

7 Systems of Representation

Since the first edition of SDR, in the academic year 1999–2000, the course has been structured into six themes: Text, Figure, Image, Object, Space and Light (Madrazo 2000). The activities are re-designed every academic year, taking into account the results obtained in the previous courses. The contents of each theme, including representative examples of the learning activities and outcomes, are then summarized.

TEXT. The theme is dedicated to the study and contrast of the principles of modern architecture as expressed in the manifestoes of the early twentieth century avant-gardes with the ideas that are being debated in contemporary architecture. In line with this opposition, other issues related to graphic design, typography, visual poetry, communication and digital media are addressed.

Activities are undertaken along two parallel sequences (Figs. 3 and 4): one dedicated to the individual study of texts and to the collaborative construction of a vocabulary of concepts drawn from their interpretation; the other is focused on the translation of ideas derived from the reading of the text into graphic formats (multimedia presentations, expressive typography) disseminateand their consequent dissemination them through various digital and analogue media (blogs, exhibitions).

FIGURE. This theme is concerned with abstraction in painting, colour and composition, Gestalt laws, and the synesthetic relationships between musical form

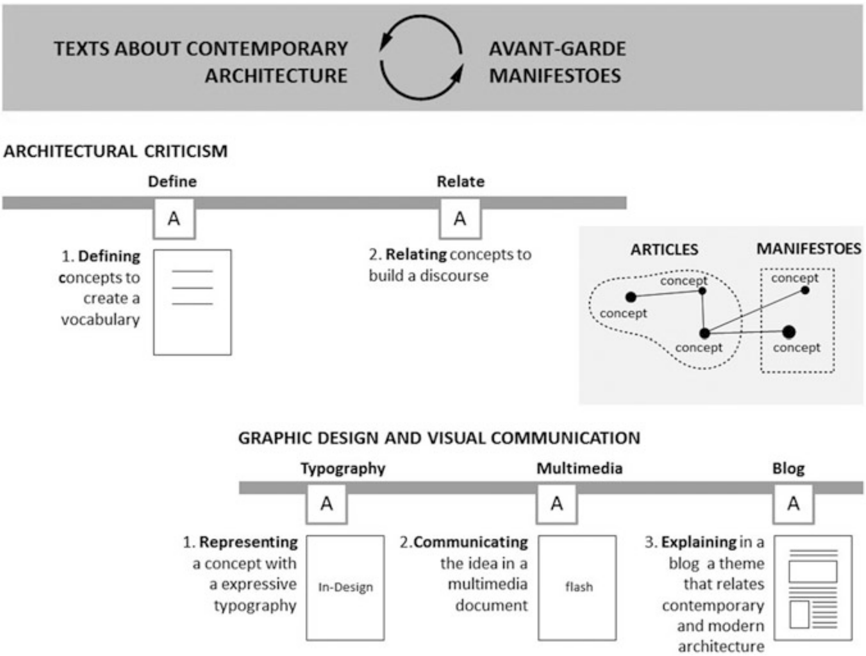

Fig. 3 Sequences of activities of the theme TEXT

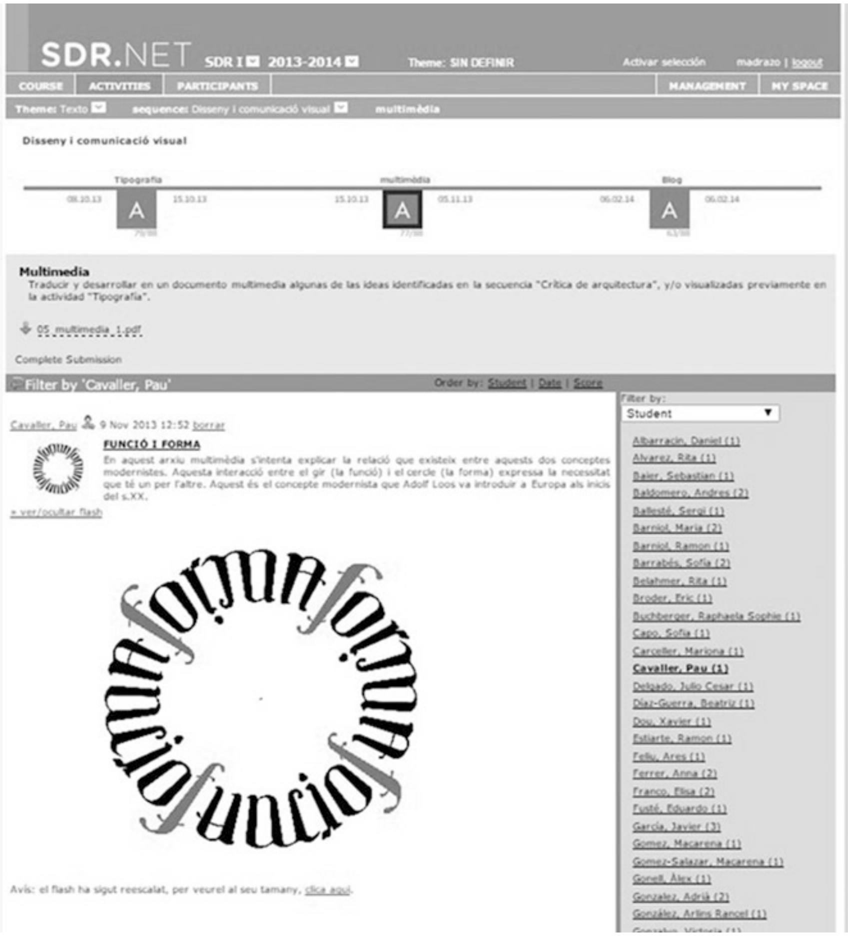

Fig. 4 Students' works in the sequence "Design and visual communication" of the theme TEXT published in SDR: NET

and visual composition. The learning activities are dedicated to analysing the structure of a work of concrete painting and to representing it through a computer animation; to translate a musical composition into a visual one and to create a series of variations on a theme (Fig. 5).

OBJECT. The theme is dedicated to the generation of three-dimensional objects based on three formal languages: line, plane and solid. Each formal language conveys a particular way to relate form, material and space. The study of the avant-garde works—mostly from Constructivists and Neoplasticists—helps to understand the notion of formal language. The works are carried out using digital media (Sketchup, 3dStudioMax and Grasshopper modelling software), sketches and physical models.

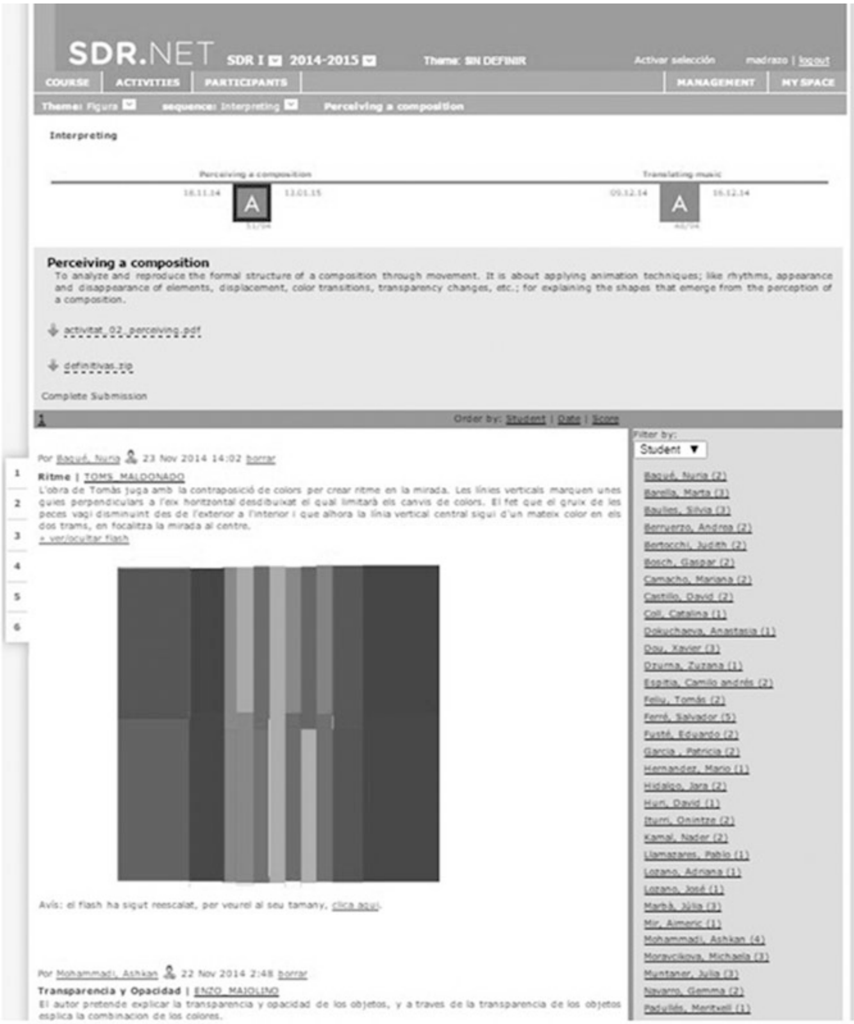

Fig. 5 Translation of a concrete art work in an animation after the rhythm of a piece of music

The development of an object is performed sequentially (Figs. 6 and 7). The starting point is the creation of a three-dimensional object from a material and a technique chosen by the student. From the results obtained, it is then possible to create a digital model followed by the construction of a physical model, to do it the other way around, or to build the digital and physical models in parallel. The last activity of the sequence is to present the process of development of the object, its successive translations and transformations in poster format. The posters and the physical models are exhibited in the school premises.

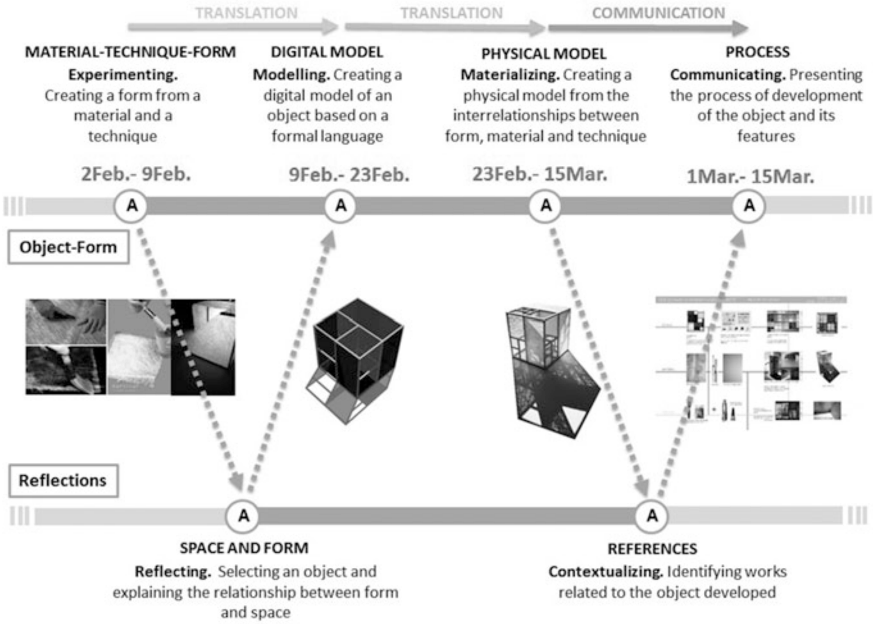

Fig. 6 Sequence of activities of the theme OBJECT with the possible connections between the various stages

IMAGE. The theme is dedicated to the study of the photographic image from an interdisciplinary perspective that interrelates photography with art, advertising, and new media in accordance with the philosophy of the *Visual Studies* (Mirzoeff 2003). The goal is to understand the world as mediated by the image, using photography as a tool to reflect and communicate ideas about architecture and the contemporary city.

The activities are organized into three sequences: Perception, Reflection and Communication. "Perception" is dedicated to reading a text about the contemporary city (e.g. "The Generic City" by Rem Koolhaas) to then to take photographs of the city that illustrate the ideas of the text. These photos are then stored in SDR: NET, classified by concepts. "Reflection" involves deriving ideas from the library of images, organizing the photographs by topics and categories. Finally, in "Communication" students produce two pages for a publication that summarizes the work of the whole class. In the last two editions of the course, the theme IMAGE has been carried out with the participation of the Escuela de Arquitectura, Universidad San Jorge, from Zaragoza, and the Faculdade de Arquitetura e Urbanismo, Universidade São Paulo (Madrazo et al. 2014). The three schools have shared SDR: NET to design and implement the joint learning activities (Fig. 8).

SPACE. The theme focuses on contrasting two space concepts: conceived space and perceived or lived space. The first one is the space that is designed and represented through geometry; the second one is the space of experience, the places that individuals endow with meaning. The moving image and the video are the

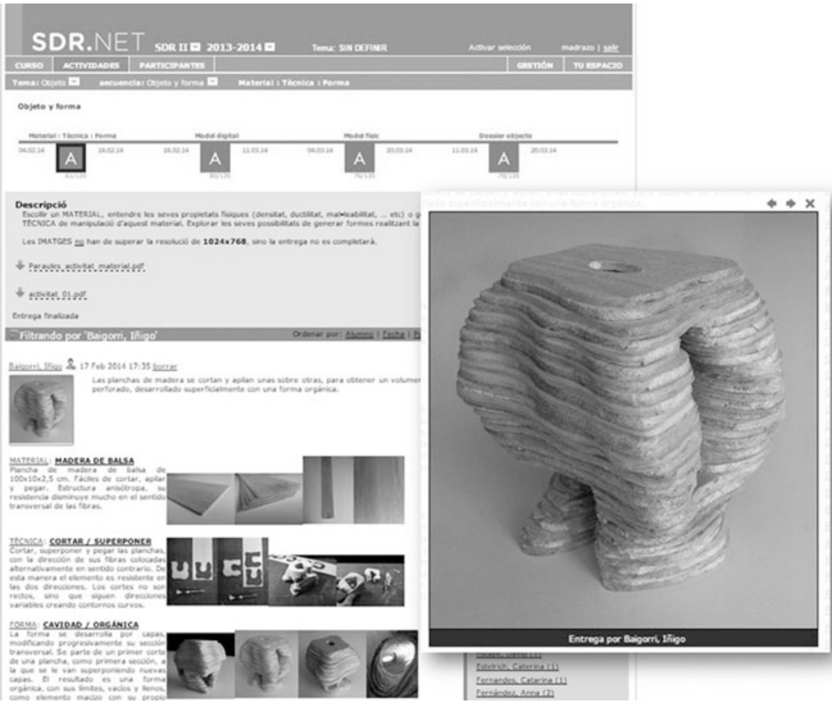

Fig. 7 Presentation of an exercise on SDR: NET corresponding to the first stage of the sequence "Object and Form"

techniques that are used to represent, reproduce and communicate the experience of lived space.

In the last four years, the activities in this theme have been carried out under the UMVA program—in Spanish, *Unidad Móvil de Vídeo Arquitectura*–, an interdisciplinary project carried out in collaboration with the LOOP Festival of Barcelona.[4] The aim of this educational program is to use video as a tool and as a medium to analyse and communicate the experience of space (Fig. 9). Students, tutors and audio-visual artists collaborate in the production of the videos.

LIGHT. The theme is devoted to the interaction of light and space, and to its representation in visual media such as painting, or to its reproduction in installations such as the ones made by James Turrell. Learning activities explore the interaction between light and space with physical media (physical models) and digital media (renderings). In both media, light is considered as a material for creating an atmosphere that determines the quality of a space, beyond its geometric and material characteristics (Fig. 10).

[4]http://umvascreen.blogspot.com.es/.

Fig. 8 Some reflections published on SDR: NET as a result of comparing the cities of Barcelona and São Paulo from photographs taken by students from the two schools

Fig. 9 Videos that reproduce the urban space experience published on UMVA's website

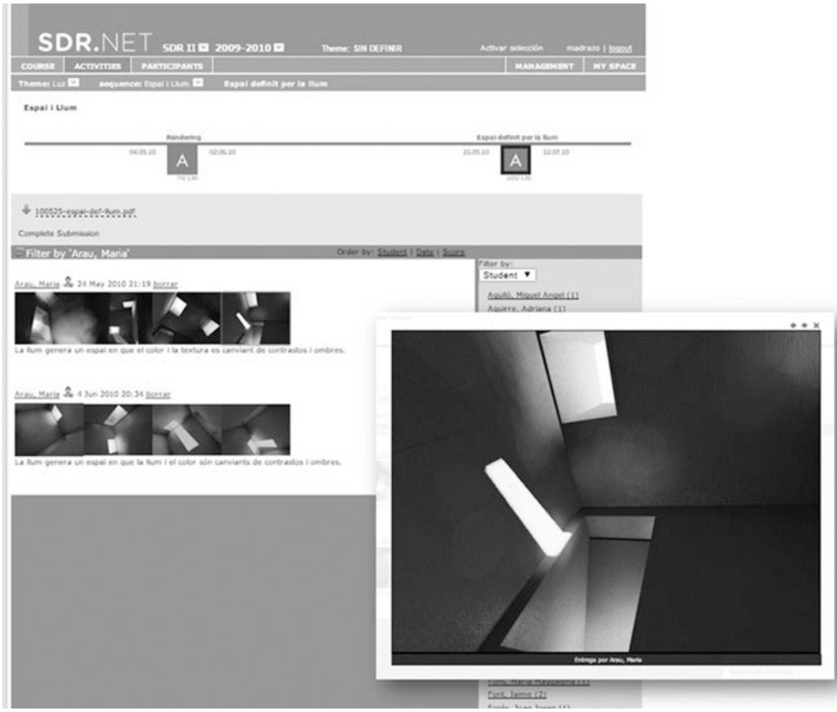

Fig. 10 Exercises that explore the interaction between space and light with digital media, published on SDR: NET

8 Conclusions

In the SDR—Systems of Representation course, teachers and students participate in the construction of an open and dynamic knowledge network which encompasses various subjects, materials, media and techniques. Through the learning activities students develop a way of thinking and doing that will enable them to address some of the challenges architects must face in today's society: to integrate knowledge from diverse fields around an architectural project; to develop strategies to involve other stakeholders (professionals, citizens) in the process of ideation; to make a proper use digital technologies in the processes of design and construction; and to communicate effectively, through the use of the media and techniques of our time, the values that architecture brings to society.

Acknowledgements In the courses taught since the academic year 2007/2008, Mario Hernández, Ángel Martin and Albert Vallverdú, architects, and Marta Sabat, a graduate in fine arts, have collaborated in the design of the learning activities and the orientation of the groups of students. We would also like to acknowledge the contribution of those students who with their motivation, dedication and effort have made this course a space for the construction of knowledge. Finally, the author would like to thank Lisa Kinnear, who did a final proof-reading the text.

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Photomontage of Images with the Same Point of View

Ramón Maestre López-Salazar and Pablo Jeremías Juan Gutiérrez

Abstract The aim of this article is to present a simple method which simplifi the laborious realization of an architectural photomontage thanks to powerful computer graphics techniques available nowadays. The proposed strategy is based on a simple data capture: it is only necessary to know the relative position of the point of view of the photography and the position of four points of the environment. It is easy to reproduce the scene, we can obtain an image of the future building from this point of view, placing the picture plane as interest us. Knowing the homography between these two planar images, controlled by the relative position of these four points, it is very easy to combine both pictures in the photomontage. Obviously this procedure is combined with proper attention to factors of sunlight and lighting and obstructions, to fi obtain an architectural image of modifi reality.

Keywords Architectural photomontage · Homography · Conical perspective · Photo-infographic perspective · Photography · Optical distortion

1 Introduction

The main objective of an architectural photomontage is to get a two-dimensional image of a building proyect. This way of composing images can be used to reconstruct (graphically) a past reality, to test different possibilities for action or (simply) to show a specific alteration of the photographed reality. Undoubtedly, this is a method of graphic expression useful in the representation of architecture that links and combines geometric principles of the conical perspective and of the photography.

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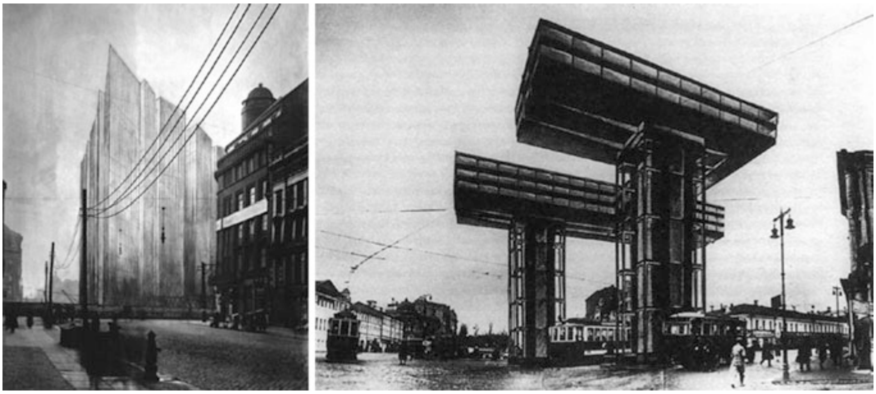

Fig. 1 Photomontage of Mies van der Rohe. Friedrichstrasse. Berlin. 1921 (*Left*). Photomontage of El Lissitzky. Wolkenbügel. Moscow. 1924 (*Right*)

All types of photomontage are based on the same principle: the development of a specific image from other previous. If we refer to the architectural photomontage, several types are known: (a) linking a perspective image of a building with a photograph of the environment, (b) the photomontage of a photograph of an actual model of the building with a photo of the environment and (c) the photograph of a real model with a virtual environment[1] (Fig. 1).

We will focus on the first procedure (a), which (currently) is the most used in our discipline. We will see that, knowing how to use the powerful computer graphics, which are accessible to all students and professionals in architecture, there is a procedure that is really easy to use consisting of a photo-infographic perspective of a virtual three-dimensional model on a photograph of a real environment. We just need to position the point of view, there is no need to reference the main ray or its visual picture plane, which may be in any orientation.

This overlap used to be done manually, with conventional photographic tools, and it was a complex process with imprecise results and with a difficult data collection. The most difficult thing was to obtain the accurate position of the picture plane (Fig. 2).

2 Geometric Approach of Architectural Photomontage

To create an architectural photomontage of a conical perspective and a photographic copy of an environment, you should always (rigorously) enforce the following geometric conditions:

[1]Which is usually performed in the film scenery.

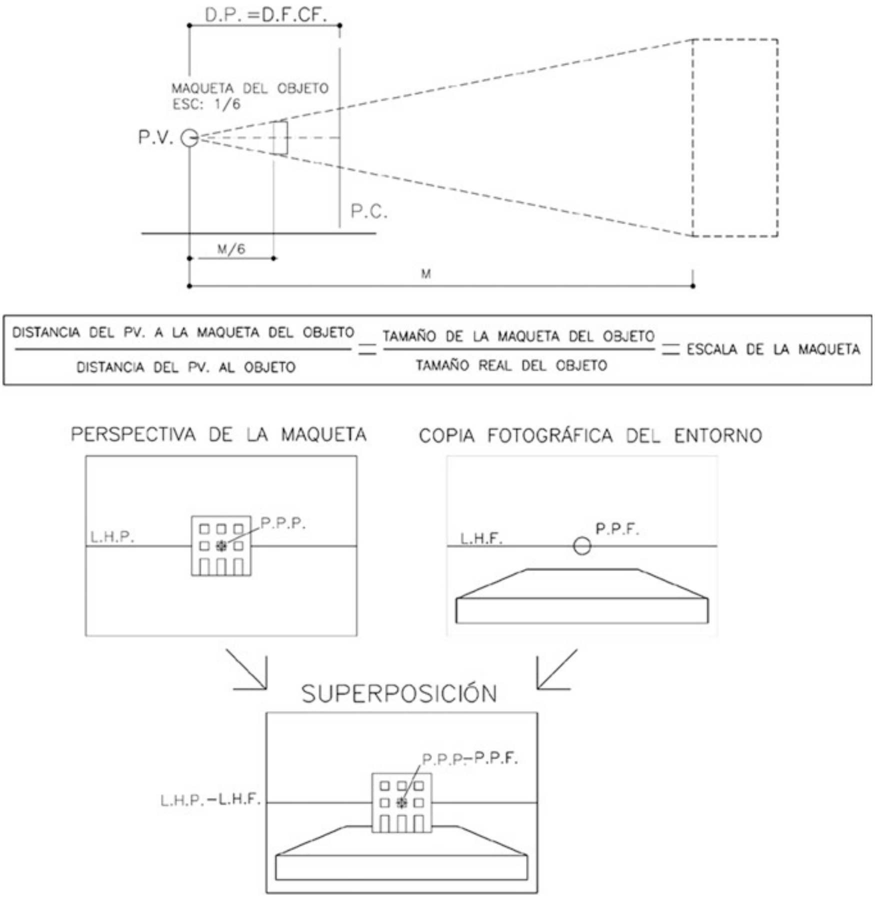

Fig. 2 Traditional photomontage method. General case with vertical picture plane. The distance from the point of view to the model should be proportional (relative to size) to the distance from the point of view to the real object. Overlapping images is performed after matching the primary point and its skyline

(1) The point of view of the environment photography must concur with the point of view of the photo-perspective.
(2) The main visual ray of the environment photography must concur with the main visual ray of the perspective photography (the photography picture plane must be parallel to the photo-perspective picture plane).
(3) The focal length of the environment photograph must match with the perspective one, so that the size of both images corresponding to the overlay.
(4) The main points of perspective and photography (and the respective skylines) should match in overlapping images.

Fig. 3 Traditional method of photomontage. Special case with tilted picture plane. The photography of reality and the virtual model image must match perfectly to overlap

(5) We assume that the photographic image of the environment has the radial optical distortion corrected in order to work with a conical projection on a perfect plane.[2]
(6) The configuration of the shadows of photographic perspective should be like the environment photograph one, which means that the direction of the light rays must be the same in both cases (and with the equivalent type of light).

We can see a theoretical reproduction of the problem in a particular case (Fig. 3). Naturally, with the traditional method of photomontage (after obtaining both images, in order to correctly perform their overlap) is necessary to crop the image perspective properly so it fits in the picture of the environment. Later we must also cut obstructions, usually urban elements that appear between the point of view and the position of the building in the photograph, to improve the result of the graphical representation.

3 Simplified Method of Photomontage. "Of the 4 Points"

Due to the complexity, which is all expressed in the previous section, we formulate, in this paper, a method that simplifies all these issues. We can call it as "the four points". We only need these three things:

[2]We must know that a few years ago we hadn't graphics software (as for example PTlens), which corrects automatically the optical distortion of the photograph depending on the model of camera (and lens).

(1) The photo-perspective must be done from the point of view with the same (proportional) position that has the point of view of the environment photo.
(2) We must know the location of 4 points of reference in the environment, which may not necessarily be coplanar (on the same plane). Three of them cannot be aligned (on the same straight line) in the photographic image.
(3) The lighting simulation of the virtual model must be equivalent to the real environment one.

The process has two phases, the first one is the field work and the second one is the office work. During the field work we perform:

(1) Photograph of the environment: In our example this photograph was taken with a camera provided with a lens (focal length of 28 mm) and, as you can see, we had to tilt the picture plane so that the whole environment was inside the visual field.
(2) Dimensions of the situation of the point of view of the camera in the context: In our case the situation and height of the point of view of the camera is simply got by triangulating with a measuring tape the points A and B.
(3) Choice of 4 points of reference and measures of their proportional position. These points should be easily identified in the photography (and as far as possible from each other).[3]
(4) We must know the illumination, usually solar, at the time of the environment photograph.

In the second phase, the studio work, the steps are:

(1) Drawing of the virtual model of the building with the aforementioned four points and, where appropriate, development of a digital model of the environment. In our example we have drawn with the computer the facade of the building, as well as the volumes of the dividing buildings, everything correctly oriented and placed in their corresponding geographical coordinates, and we have placed in it four small red spheres exactly in the corresponding position of the four benchmarks.
(2) We must obtain the conical perspective image (vertical picture plane) of the model by rendering. In our case with a virtual light equivalent to sunlight (parallel rays), We position the cast shadow of the building on the left (and on the right).[4]
(3) We must combine the image of the render and the image of the environment in the software, in our case with Adobe Photoshop. This problem involves the following operations: cut, fit and finish.

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[3]By the same procedure metric data base has been taken in order to draw the volumes of surrounding facades. All these measures are available with a GPS.

[4]This operation is performed by the software automatically by introducing a solar light.

3a. Cut the silhouette of the projected building.
3b. With a planar and homographic transformation of the photographic image (and using the transparency thanks to this type of software), we must ensure that the four reference points located on the photograph match with the centers of the four circles appearing in our render.[5]
3c. Trimming obstructions of the environment.

3e. Adding projected shadow of the building on the environment.[6]

In our case, we have done this procedure by removing shadows from one of the buildings that is intended to replace (on the building on the right of the photograph of the environment).

3f. Deletion of the reference marks of the final image (Fig. 4).

We can see an example of this simple way to create architectural photomontages (Fig. 5), without having to use the data of the main visual ray of the photography. In this case the homographic transformation was performed on the photograph of the environment to suit the image of vertical picture plane obtained with the render, because these type of images are seen as more expressive in representing architecture.

As we can deduct from our example, in the case of photomontages of buildings in urban contexts, it is easy to reference the four points needed, but in the case of a different environment in which we do not have references, we can use two vertical guides on which we can measured and score the four points that we will need.

4 Conclusions

Therefore, to create a good architectural photomontage, with an image-photo-perspective of a virtual model on a context photograph, we just need to have the location of four reference points on the photograph, the proportional position of the common point of view and the data of natural lighting (in its case).

Using a homography of an image in conical perspective you can get all the perspectives from this point of view, corresponding to the infinite possible orientations of the picture plane. It can be deduced that for a photomontage of these two images. It is enough with matching the four reference points taken in both images.

The photo-perspective of a building can be drawn on a vertical picture plane (pointing the ray horizontally into the building). If the photograph of environment has vertical or tilted picture plane… it doesn't matter: We can always adjust the overlap of the two images using the homography.

[5]As we know, using the tools of the computer we can create a homographic image.

[6]The introduction or the deletion of shadows of our building (on the environment) can be done by changing the color of the pixels because a lot of software incorporates a color analyzer.

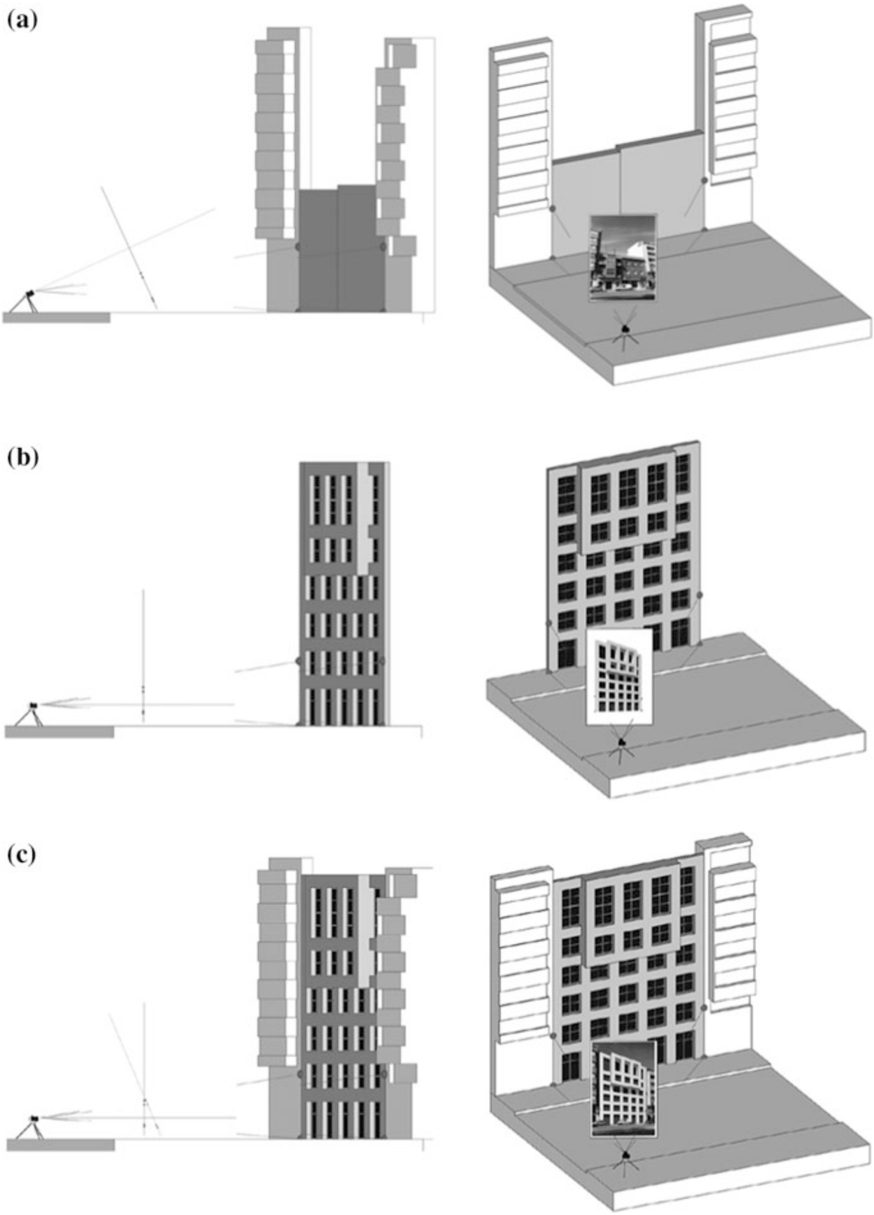

Fig. 4 Method of the four rays: **a** Photography of the reality (picture plane in any position) taken from any point of view. **b** Photo-perspective of the model (vertical picture plane) from the same (proportional) point of view. **c** Photomontage of the two images overlapping the corresponding 4 points

Fig. 5 Process of homographic transformation of the photo-perspective with the software (see Fig. 7)

Naturally, instead of adapting the photograph of the environment to the photo-perspective, as we have seen, we can also adapt the opposite (the photo-perspective to the photograph of the environment) (Fig. 6). We can see that, starting with the same data base, in this case (Fig. 6), we can make the homographic transformation to the photo-perspective, "stretching" the points A, B, C, and D to the points A′, B′, C′ and D′, respectively. We observe that the render image of

Fig. 6 Homographic transformation of the environment snapshot "stretching" the environment image until the points A, B, C and D match their counterparts A′, B′, C′, D′

Fig. 7 Homographic transformation of a photo—perspective "stretching" the points A, B, C and D and matching them with their counterparts A′, B′, C′, and D′

vertical picture plane becomes into an image with tilted picture and therefore the result is a tilted picture plane perspective.[7]

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[7]Finally, as we know, there is also the possibility of transforming the image of a photomontage result, as seen in Fig. 6, by manipulating the geometry of the photographic image, for example to accentuate the verticality and horizontality of the picture. The homography also allows these transformations in which the result is not really a conical projection, but a second projection (cylindrical or conical) of the image.

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Learning to Read the City Through Drawings: Michelucci's *Aurum* in Pescara

Caterina Palestini

Abstract The contribution focuses on the teaching experience conducted within a laboratory theme treated during the course of Representation, coordinated by me, from which subsequently have become an exhibition and a study day dedicated to the reading of an emblematic building for the city of Pescara. The objective was to investigate experimentally, using the representation tools, a connotative architecture of the city: the *Aurum*, an industrial building designed in 1938 by Giovanni Michelucci, today museum center and "factory of ideas". The original project and its realization have constituted an opportunity to analyze in terms of graphic the architectural spaces, in relation to the place and to the city.

Keywords Drawing · Heritage · Architecture

1 Objectives and Methodological Premises

The choice to employ the tools of representation to retrace the form and values of a work of architecture through its relations with the city guided this experimental research, focused on defining an alternative methodology of study based prevalently on the analysis of graphic material. The operation was conducted as part of a third year workshop offered by the *Dipartimento di Architettura* in Pescara.

The exercise examined one of the city's most representative buildings, retracing its transformations and socio-cultural implications through the evolution of its urban context. This same method was then re-proposed in other case studies.

The building in question remains one of the most important structures in modern Pescara, both for its architectural qualities and position in a large pinewood originally identified as the site of the city's expansion toward the waterfront.

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This unique building was designed in 1938 by Giovanni Michelucci for a company producing typical products of the Abruzzo region, preserves and elixirs, including the renowned orange liqueur that gave the building its name. In fact, it was an intuition of the local poet Gabriele d'Annunzio to associate the Latin "*aurum*", literally gold, with the golden colour of the liqueur distilled from the precious fruit.

The fortuitous combination of choices made by the enlightened businessman Amedeo Pomilio to invest in the production of high quality artisanal products that would earn him international recognition during the second half of the 1930s, and commissioning of a renowned architect to design his factory, produced a work of architecture that would prove important to the future of the city of Pescara and its territory.

Giovanni Michelucci's project is in reality an expansion, an interesting and, for the time, innovative proposal to refurbish and reuse an existing maritime pavilion, the historic "Kursaal", which he absorbed into the new project. The main elevation was, in fact, defined by the original façade of the building to which a horseshoe-shaped structure was attached. The new spaces were designed to host offices and the articulated series of processes tied to the production and packaging of the company's products.

2 Urban Analysis

The importance of the site was already demonstrated by the decision to locate the Kursaal here. Inaugurated in 1910, it was constructed in accordance with the typology and stylemes typical of summer vacation destinations as a space for recreational and social activities. The building was situated at the terminus of the tramline that provided a link with the city's rail station (Fig. 1).

This strategic position delineated the fulcrum of the new residential-tourist district of the *Pineta*, the pinewood that, according to the Master Plan developed by the engineer Antonino Liberi, would define the future expansion of Pescara: a garden city of tree-lined boulevards and small *villas* occupying lots at the edge of the pinewood and the sea.

Liberi laid out the new plan according to a trident of streets, with two main boulevards leading to the beach; at the centre, in the upper part of the triangle, he placed the pavilion on axis with the water and the city. This latter delimited the new bathing district, defining its entry gate, and served as a hinge of the roads leading toward the centre of Pescara and the provincial road to Francavilla.

The Plan also laid out the city blocks, organised according to a modular grid of orthogonal streets, parallel and perpendicular to the water, with the two exceptions of the aforementioned diagonals running tangent to the Kursaal.

The building limit was set at 40 m from the coast and organised on rectangular lots occupied by small *villas*. This ambitious project, which required the public acquisition of all lots, was slow to take off. What is more, it clashed with the interests of private land owners and the inadequate normative-financial instruments

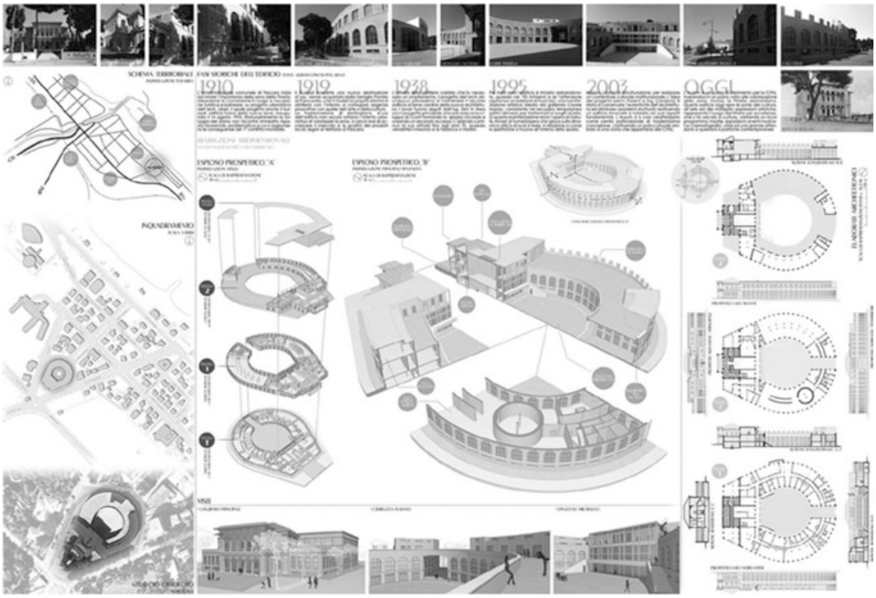

Fig. 1 Urban analysis, survey and graphics of *Aurum* building in Pescara

available to the city that, when it became aware of this situation, modified the Plan with a successive "*Piano di risanamento della contrada Pineta e piano Regolatore edilizio per trasformare la plaga risanata in quartiere climatico balneare*" (Plan for the rehabilitation of the Pinewood and Master Plan for transforming the rehabilitated beachfront into a summer bathing area).

Despite the changes and best of intentions of Liberi's Plan, which also boasted a modern approach to the defense of the natural qualities of the pinewood based on the European model of the garden city, the conditions necessary for the realisation of the district were never found, initially due to the outbreak of the Second World War, and successively to the spontaneous creation of a new bathing area on the other side of the Pescara River (Bonamano et.al 2003).

Along the bare coastline north of the River speculative and autonomous mechanisms shifted the position of the modern city tied to the presence of the rail station, constructed in 1862 in a level area in the periphery of the neighbouring village of Castellamare Adriatico. The position of the station projected the city toward a rapid and undisciplined evolution along the coast. Things remained this way even after 1927, the year the two nuclei were joined to form what is now Pescara. Unoccupied State lands toward the northern coast were seen as the ideal site for a very rapid and profitable expansion with respect to the restricted, and unsuccessful, realisation of Liberi's plan.[1]

[1]Cf. A. Alici, "*Le vite della città*", in *Pescara, forma identità e memoria della città fra XIX e XX secolo*, Edizioni Carsa, Pescara 2004, pp. 23–36.

Returning the area of study, the Kursaal, no longer able to function as a recreational structure, was left abandoned until 1919 when the city awarded it to the Pomilio family for their business activities, planned from the outset in harmony with the environment and territory, as established by a direct regulation dictated by its previous use.

The appropriate choice to locate a distillery in close contact with a natural setting, surrounded by a forest of pine trees and sand dunes covered with spontaneous aromatic shrubs, represented a prime opportunity for the revitalization of the area that was gradually populated in the wake of the flourishing activities of the distillery (Di Biase 2007).

Liberi's Plan was thus partially implemented, and directly tied to the expansion of the factory that served as a centrality for the area's development.

Over time the Aurum building assumed the role of an urban monument.[2] Michelucci's project reinforced this underlying mission by considering the structure not only as a space of production, but also as an economic and cultural centre for the rest of the city.

An avant-garde vision of the factory's expansion exceeded the construction of simple buildings outlined in an earlier proposal,[3] and adopted a precise and far-seeing idea attentive to the needs of the factory and improvements to the quality of the workplace, with consequent benefits and comforts for employees and the city (Figs. 2 and 3).

Continuing its original vocation as a destination for tourism, the new construction was designed to host cultural events and concerts in the internal courtyard. The project also included a proposal for exhibition spaces that would document the traditions and flavours of Abruzzo, considered a precious legacy to be passed on. With this in mind, the astute programme pursued by Amedeo Pomilio included a proposal within the complex of the Aurum for a school-shop that would promote artisanal activities and enogastronomy and favour the teaching of typical local trades, at the time facing the risk of extinction, presenting them to visitors as examples of the region's treasures. Unfortunately this vision was thwarted by the outbreak of the Second World War.

The rediscovery of these surprising programmes, which almost exactly mirror those proposed today—we need only consider the notion of sustainability and the themes proposed by EXPO Milano 2015—guided our research toward an understanding of the building's various potentialities: urban, architectural, productive and cultural. The architectural container and its contents were analysed, decomposed and re-elaborated in relation to future projects and hypotheses for the development of its role within the city.

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[2]Cf. C. Pozzi, "L'infanzia della città", in *Pescara, forma identità... op. cit.*, pp. 37–45.

[3]An image of the first and more anonymous unsigned project, dated 1938, is published in "Aurum e Pescara sud, una costruzione in parallelo", by Piero Ferretti, in *La fabbrica dell'Aurum in Pescara. Impianto, sviluppo, restauro,* Tavano Giovanni, Capanna Ilvi (eds.), Edizioni Carsa. Pescara 2007, pp. 28–28.

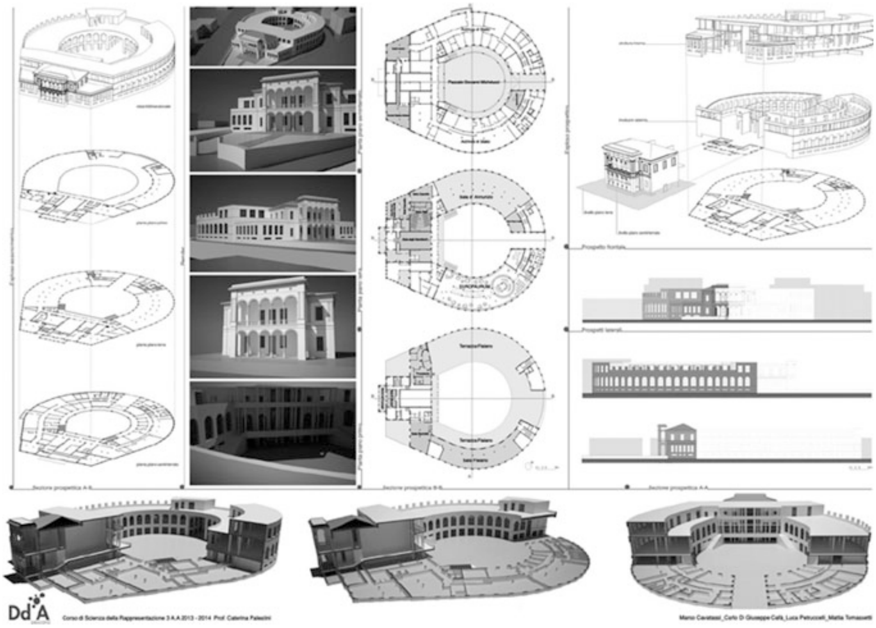

Fig. 2 Graphics readings through digital study models

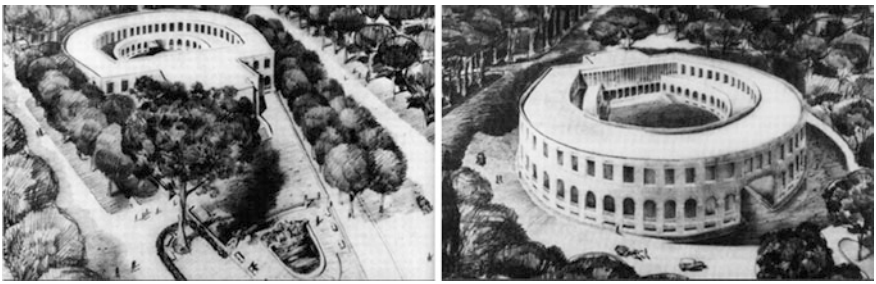

Fig. 3 Perspective views of the two sides of Michelucci original project

3 Architecture: Michelucci's Design

The project developed by Michelucci responded to the "teardrop" shape of the site formed by the trident road layout. It exploited this shape by expanding toward the sea in the form of a semi-circular "horseshoe" grafted onto the pre-existing structure of the Kursaal.

Contemplating the requests advanced by the client, the factory was structured on three levels and organised around a central courtyard. The result offers a view of the entire structure, realised in reinforced concrete and masonry.

The building's classical inspirations, revisited in a Rationalist key, are typical of the architectural language of the Tuscan master and can be found in other works from the same period. What is perhaps most surprising here is the grandeur applied to an industrial typology. It is an amphitheatre that becomes a factory, with a sequence of large arched openings defining the wrapping side elevations, stretching as far as the broad fornix marking the entrance in the façade facing the sea.

The initial project, while maintaining the memory of the façade of the Kursaal, proposed a stylistic revisitation, uniformed to the new construction, as depicted in a scenographic charcoal perspective.[4] Other differences from the final result can be found in the drawings of the plans, elevations and sections of an early proposal depicting a more austere treatment of the courtyard elevation, laid out as a succession of arches continuing those to the sides, and different levels for the ground floor, initially a half-basement (Bardeschi and Guarisco 1992).

Additionally, other bird's-eye perspectives emphasise the plasticity of the building surrounded by the pinewood, with the front elevation facing a small square with a fountain, and the rear elevation presenting a large fornix for a second entrance, through which it is possible to see the elevation of the courtyard, already modified to reflect the sober linearity of the definitive solution. The elevation functions as a *galleria*, connecting the pre-existing structure of the Kursaal with the graft of the two semi-circular arms inside the courtyard. It depicts the slender columns defining the modular rhythm of the glazed elevation used to filter light into a full height space behind it, designed to host the distillery's large alembics. The elevation is defined by a Rationalist rigour and purity that harmonises the different elements of the composition: the ancient, the classical and the modern (Giovanni and Ricci 1962).

Other signed drawings, dated 1939, describe the architectural details of the masonry work and windows, at a scale of 1:50, also represented in detailed perspectives.[5]

A considerable quantity of original drawings, of which only a few remain,[6] allowed the resolute client to proceed with construction, between 1940 and 1945, supported by the local engineer Zeri, who, despite introducing a number of changes, did not alter the general *parti* of the original composition.

After the War, the factory faced a period of crisis, due also to the introduction in Italy of new drinks that gradually surpassed the Abruzzo-made liqueur; throughout

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[4]The unsigned charcoal perspective and a selection of general drawings refer to an early and unbuilt solution. Cf. L. Cavallari, *Dalla Fabbrica al Riuso*, *idem*, pp. 52–53, 60.

[5]Cf. R. Mennella, *L'Aurum di Michelucci, ovvero l'Aurum di Pescara*, *idem*, pp. 66–67.

[6]The project must originally have been accompanied by a vast number of drawings. Found material relative to architectural details, signed and dated May 1939 are titled *Nuovo stabilimento distillerie "Aurum" Pineta di Pescara* (New "Aurum" Distillery Complex in the Pinewood of Pescara). This material is numbered "*Dis. N.40*" (Drawing n. 40), which substitutes drawing n. 32. Cf. I. Capanna, "Forme dell'Aurum", in *La fabbrica dell'Aurum... cit.*, p. 71.

various events the factory in the pinewood continued to function until the 1970s when, passed from business to business, it was purchased in 1977 by a multinational enterprise that shifted operations to Città Sant'Angelo (Figs. 4 and 5).

Following its decommissioning, the factory slipped into a slow process of decay, at one point facing the risk of demolition to make way for a private real estate

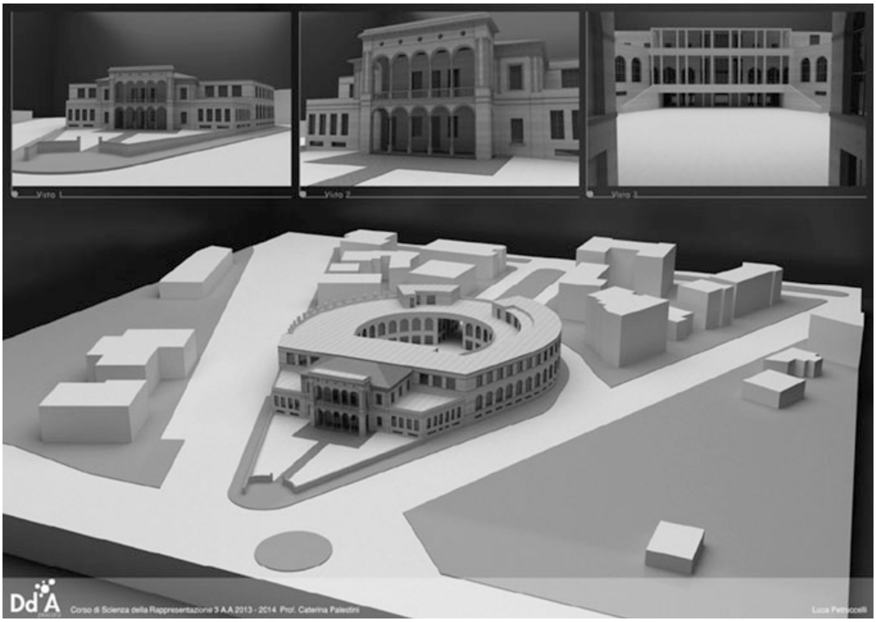

Fig. 4 Three-dimensional study models

Fig. 5 Graphic reinterpretations of *Aurum*, seen through the pixel art

operation. Fortunately, its urban and social role was recognised by local citizens who mobilised to save the structure from being destroyed.

The cultural importance of the site resulting from the presence of the *Aurum*, after a series of public acquisitions that made no inroads to halt its decline, became the focus of a series of cultural events, including the 1995 exhibition *Fuori Uso* (Out of Use). This important showing of figurative arts included works by contemporary artists invited to reinforce the importance of this work of architecture to the city (Bonamano and Ferrini 2000).

The complex was reacquired by the City and restored in 2005–06. It is currently used as a multipurpose museum. It features a half-basement ground floor with a height of 3.50 m and a total floor area of 3500 m^2; an upper floor with the same area and a height of 5.00 m, comprised of two symmetrical annular galleries lit from both the interior and exterior elevations through the sequence of arched windows. The third floor, which has remained incomplete, is built on one side only. The unfinished portion of the uppermost ring is used as a terrace, extending toward the space of the central courtyard used for performances during the summer months (Giovanni and Capanna 2007).

To consolidate the building's cultural role, an agreement was recently stipulated between the City of Pescara and the *Dipartimento di Architettura* for the organisation of events, exhibitions, seminars, workshops and initiatives tied to educational activities and scientific research of interest to the general public, organised in the spaces of the university and the Aurum.

This cultural programme, which I coordinated, generated the idea behind the research described here: adopting an educational experience focused on the synergetic comprehension and communication of the characteristics of the city. The obvious starting point was identified in the significance of the Aurum building, already investigated in historic studies carried out as part of its restoration, though scarcely explored in analytical terms and in relation to issues of representation. What is more, to date, this historic material is almost completely unknown to students of architecture studying at the nearby "G. d'Annunzio" University.

4 Graphic Readings

These premises generated the proposal to analyse the *Aurum* building using the tools of representation, with readings and formulas of expression useful to comprehending its urban, architectural, artistic and cultural values. The results were presented inside the building itself in an educational exhibition designed for the visiting public.

Michelucci's original project, and its construction, constituted the stimulus for a graphic analysis of architectural spaces that are not immediately comprehensible, given the complexity of the structure. They were also investigated here through the history of its construction, described in relation to the site and the city.

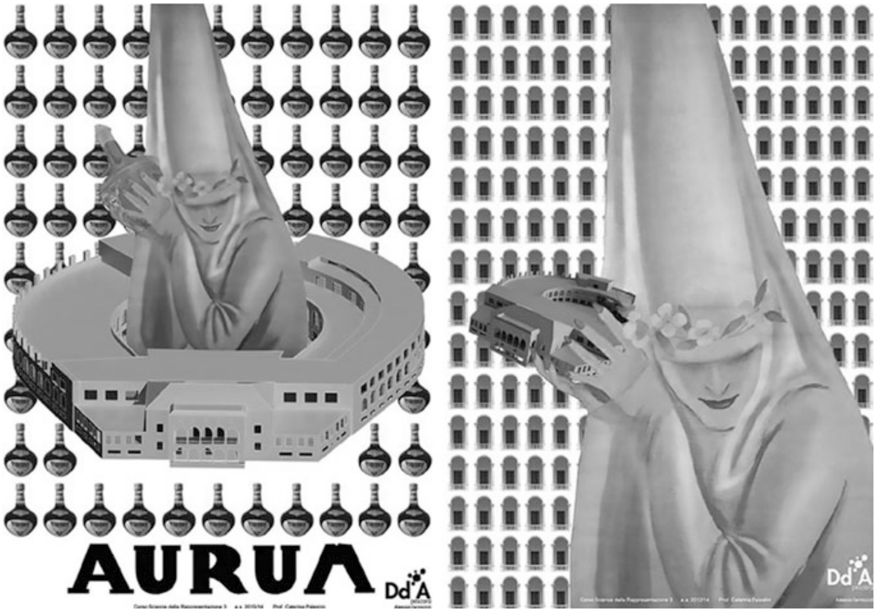

Fig. 6 Graphic elaborations of the advertising poster designed by M. Dudovich

Two- and three-dimensional study models allowed for an understanding of the parts of the building, which were decomposed and reassembled like a puzzle. This was made possible by drawings and documents that adopt both traditional languages of drawing and those made possible by digital tools.

From more technical and canonical documents, based on a survey and the current configuration of the building, the research moved toward more fantastic explorations, inspired by Pop art, comics and visions that transform the building's architectural elements, replicating them to compose imaginary works of architecture.

Particular attention was focused on the graphics used to advertise the liqueur factory's products, realised by Marcello Dudovich, a well-known illustrator from this period who worked for some of Italy's leading companies,[7] including: Campari bitters; Martini & Rosso Vermouth; Strega liqueur and China Pedroni. For Aurum he realised the famous "Fatina bianca" (White Fairy) poster, inspired by Catherine de' Medici, the cultured Florentine patron admired by the head of the company. Stereoscopic and holographic visions complete the fantastic sequence of images

[7]Marcello Dudovich was a highly talented artist, illustrator and graphic designer. He is considered one of the founding fathers of advertising graphics. He designed posters and billboards for important automobile companies such as Fiat and Alfa Romeo and various other Italian manufacturing companies. Cf. G. Mughini, M. Scudiero, *Il manifesto pubblicitario italiano: da Dudovich a Depero, 1890–1940*, ed. Nuova arti grafiche Ricordi, Milano 1997.

Fig. 7 Preparation of the exhibition spaces of the Hall “d’Annunzio”

Fig. 8 Working group, course of “Science of Representation 3” academic year 2014–15

presented during the exhibition presented in the Sala d’Annunzio, situated in one of the large annular spaces now used for exhibitions and dedicated to the famous Abruzzo poet, a friend and fan of Pomilio.

5 Conclusions

The educational experiment and study of the *Aurum* building stimulated interesting responses from City Government and local citizens, offered the possibility, thanks to the immediacy of the language of graphics, to learn about the importance and role of the building throughout its many historic transformations (Figs. 6, 7 and 8).

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Expressions, Representations and Interpretations of the Public Space, from Intellectual Disabilities, in the Teaching of Architecture

Ángel B. Comeras Serrano

Abstract Society is complex and diverse and it seems necessary to accept, to understand and to bet for cognitive differences. The public space is used by everyone and it should serve for all. These teaching essays in architecture can dispute the usual approaches to formal generation of urban space. Translation and interpretation, through digital instruments and current technological advances, can point to a distance between the objectives pursued by the urban design and the objectives accepted by today's society, without any exclusion. Therefore to new ways to resolve the public spaces of cities for all its citizens.

Keywords Public space · Perception · Intellectual disability

1 Society and Contemporary City

Today's society is diverse and complex. Globalization adds greater and interesting heterogeneity. Cultural, social, economic, political and human migration in recent decades reaffirm and walk towards a greater vagueness in uniform identities. Movements and permanent mutations produce flexible and versatile identities.[1] In the society there are, besides the stated diversity, sectors with some sort of vulnerability. According to the latest population data[2] in 2014 12% had more than sixty years, and in 2010 a 15% had a disability.[3] Since 1994, according to Cairo Conference, more than half of the population lives in urban areas and it is increasing in a permanent and substantial way. Since then all this future growth is

[1]See some of the various publications and writings of sociologist, philosopher and essayist Zygmunt Bauman (Poland, 1995) about the "liquid modernity".
[2]For additional explanatory information consult "the demographic situation in the world. in 2014 Concise report". United Nations. New York, 2014.
[3]For more information see "World report on disability". World Health Organization, 2011.

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expected to be absorbed by urban settings. The organization of urban areas has become one of the most important challenges in 20th century since the city must be able to absorb these events. And it must be translated into permanent mutations, transformations, and building growths. But it should also absorb new forms of relationship and communication, being current city more related to behaviors than buildings (Ballesteros 2008, 124). Public spaces must assist mainly to relationships and social behaviors, mobility, activity and relationship. The contemporary city has major difficulties to settle into the consolidated historic city due to its limitations of transformation and adaptation. However its privileged location and its perceptive acceptance by visual repetition and assumed figuration, produces a greater attraction. Most of public spaces in historic centers of cities have a frozen built-up situation, being its immutability the backdrop of relationships and behaviors. Small transformations usually affect only the horizontal plane, the lower floors with changing commercial activities (segments of vertical planes close to the ground) and small cover up operations in the rest. When you replace a building, urban and figurative limitations prevent any purposeful capacity, tending to mimesis. The activity and daily behaviors by themselves transform and adapt minimally consolidated and immovable spaces. What is experienced may be far from what is planned and as professor Javier Segui[4] says "no head can have inside a clear picture of something not experienced". It could be said that the previous conditions of the consolidated historic spaces are different to the requirements of the contemporary city and, of course, to their vital needs.

2 Limited and Represented Perception

If we delve into our inner (Kandinsky [1912] 1996) we can find our different possibilities of understanding and communication with the world. This will take us to personally perceive our environment as a tool for understanding, communication and relationship. Our perceptions assumed in our "personal time", together with the permanent absorption of new ones, will contribute to create a perceptional personal universe. Something as simple as the simple transmission of a color, along with our visual memory and our different capacities and nuances, produce multiple and different ways of perceiving it (Albers [1963] 1979). However our perceptional difference, plus other singularities and individualities, can build formalizations and contributions that transcend towards the collective. The limited perceptional individuality can produce results of general interest, applicable to other forms of

[4]Workshop Week 0 of ETSA USJ held in Zaragoza in September 2015. Urban books. Graphical perception of the city observed. Faculty speakers: Manuel Baquero Briz, José M.ª Gentil Baldrich, Javier Segui de la Riva and Eugeni Bach.

expression and acceptance.[5] Limited and diverse public space perception is difficult to be represented and expressed to all stakeholders that are involved in it. Drawing and the image is a recognized tool of expression and thought. Drawing as a graphic expression of what is perceived, in the words of Professor Manuel Vaquero Briz (see note 4). Drawing expresses the perception of a moment. Perception uses the senses as a tool, which manifest themselves on a whole through the interaction of all of them, with greater or lesser influence, complemented by non-existence, the experiential, emotional and personal, producing a heterogeneous and rich miscellany that makes perception to be adapted to each individual. It is therefore that the multisensory experiences in architecture (Pallasma 2008) do not take place separately; being the senses closely related and linked each other, regardless of the capabilities and limitations of some senses over the others. The deletion of any of them strength the rest serving as support, in the same way as concrete argue each point of support its limit and load capacity, moving to the rest its excess in a supportive way.

In the schools of architecture they are taught to handle the graphical expression tools to reproduce the existing and to conceive and represent their ideas and creative design processes. Physical matter is represented to try to express the experiential and sensory matter. Besides the traditional and fundamental task of drawing and laying out by hand, other instruments and technological advances have appeared. 3D printing and digital workshops have been added recently, considering them fully accepted, with multiple possibilities of development. Small models of buildings are represented with intermediation instruments. To hand-draw as starting, approaching and exploration; represent physically handmade lay outs; draw, model and represent digitally; print the digital models using 3D printing; express with other alternative tools stolen from other artistic expressions, etc. are some tools of graphic representation. Sketches, drawings and projects of multiple forms are showed. When building stories are required, limited spatial meanings are presented, as close as possible to the lived reality and to the one to be discovered.

3 Receiver Society

All our dreams can lead to places for social life because all these processes are aimed at society as user and receiver. The Fundación Arquitectura y Sociedad[6] understands the architecture as “a service that articulates, conditions and facilitates

[5]My article called “Algunas notas subjetivas sobre la percepción sensible del espacio arquitectónico” (Some subjective notes on the sensitive perception of the architectural space) explains some perceptions and expressions taken by artistic examples (see bibliography: Estepa (2015) “Taller Vertical de Integración”—Vertical integration workshop).

[6]Fundación Arquitectura y Sociedad with headquarters in Madrid and Pamplona in 2008 (www.arquitecturaysociedad.org). Understand that architecture should try to provide solutions to the complex social network, interacting with other disciplines in the creation, thought, or the economy.

the lives of the citizens". However, since the mid-20th century architecture has been identified with the ability to improve the lives of the people, being the role of the architect needed and directed toward society, having this one the stated complexity and diversity. To make it happen, every time it is more necessary to detach ourselves from our individual contribution by a collective and joint contribution. It is no longer possible to provide positive solutions to the complex social network without establishing connections with other areas of knowledge. Transversely, lately very commented, must become a reality in the architectural generation, from teaching and learning to the profession of architect. Both the hermetic departments in the schools of architecture and lonely work must extinguish to establish more comprehensive, multidisciplinary and collaborative processes without sacrificing the intimate and creative ones. It is necessary to discuss and understand at least the existing social fabric, providing a reflection on the social conception. The architecture-society relationship and its intimate and permanent contacts, that can cause integration or rejection, need the required adjustments and contributions for the whole of the citizens. And it must also to exist moments of interference and social relationship, with interventions that facilitate situations of knowledge of, at least, some of the sectors that make up society, that we don't know properly and we can find usually as users of our interventions. Positive conclusions will be extracted from our intrusion, produced from architecture and destined to the society.

4 Profile Directed Towards the Public Space

In Escuela Técnica Superior de Arquitectura de la Universidad San Jorge (ETSA-USJ), since its educational beginnings, we have been working regularly with some vulnerable sectors of society, mainly with people with intellectual disability (ID). This DI sector is characterized for having significant limitations in intellectual functioning and adaptive behavior, as manifested in conceptual, social and practical skills (Verdugo 2002), establishing three different levels: mild, moderate and deep. Studies, projects and educational activities have been attended by people older than 18 years with mild and moderate DI[7] and with abilities for urban mobility. All these tests, carried out until 2013, have been reflected in the publication "Arquitectura y Discapacidad Intelectual. Momentos de coincidencia",[8] which can serve as a reference and example in different forums. These tests have

[7]Pertenecientes a foundation CEDES, entity committed with persons with intellectual disability and development. It has its facilities in Calle San Cristóbal, 4. Zaragoza 50015. Web: http://fundacioncedes.es/.

[8]Comeras and Estepa (2013) Contains multidisciplinary research articles, practiced teaching essays and lecture on specific days. User and ergonomics, sensory interactions, communication architectures, comprehensive accessibility in buildings, etc. have been some aspects developed from mainstreaming with other areas of knowledge (Health and Communication). Areas have been diverse: working, living, education, leisure, clearances and travelled by public space.

had cognitive and perceptual aspects that go beyond physical architectural barriers and they have evolved into the full integration and social inclusion of sectors in difficulty, belonging to this diverse society, in the use of the architecture. The assistance to people with different perceptions, in which all of us are included, to question how it is currently and to obtain possibilities of improvement for all citizens that make up society, without any limitation or exclusion.

One pending aspect was to investigate and test the public space. Some tests on urban routes between specific points of connection had been carried out, visualizing and detecting common difficulties (obstacles, disorientation, etc.). Relations and social behaviors in public space, its influence and acceptance, from different or limited perception of people DI. And two public spaces (two squares) were analyzed using the test called "Accesibilidad Integral en el Espacio Público" (Integral accessibility in the public space) based on the following aspects:

- The integral accessibility should be able to see all aspects of spatial and functional improvement directed toward persons with physical limitations, sensory, cognitive and communication.
- There is an important factor and topical that is 3D printing applied in many fields (architecture, engineering, medicine, fashion, crafts, biotechnology, etc.). It is proposed in an experimental way some works on recognition space trying to represent them by drawings made by people with intellectual disabilities, integrating them into this practice, and concluding in a "cognitive scale model" 3D.
- The ability to express what is perceived, by drawing without any preparation or previous formation and its translation by "cognitive scale models".

These have been some of the aspects discussed with students in their completion of second Architecture ETSA USJ, who were already initiated and trained in digital tools of graphic expression, being aware of its limitations but it is of great interest as learning in these first years of their studies to assume in their beginning the society's constraints.

Consider "game structures[9]" that allow the combination of physical abilities and mental are important aspects to take into account. Proposed processes are based on a previous planning made with the teachers in the disciplines involved, on the organization of teams previously selected, on the fl to unknown paths and the fl acceptance of the different proposals generated by its components, without preset previous results.

[9]Some concepts can be referenced by María Montessori (1870–1952), doctor of medicine and psychologist attending educational demands of particular form for each person, in your case the children.

5 Two Public Spaces

Two squares were selected in the historic city center of Zaragoza: Plaza Ariño and Plaza Santa Cruz. Two public spaces consolidated of small scale, well-known in the city. Both are slightly rectangular (see Fig. 1) and spatially well defined.

Plaza Santa Cruz, of a larger dimension, is flat containing trees, and elements of urban furniture, being significant a pergola with brick vertical elements. The elements that it contains could be said to have historical connotations (see Fig. 2).

Fig. 1 Aerial view of the two squares object of study

Fig. 2 General view of the Plaza Santa Cruz

Fig. 3 General view of the Plaza Ariño from lower

Plaza Ariño also has a well delimited space configuration, but its base was rebuilt in 80–90s following the so-called "hard places" model applied in the fabric of the historic city of Zaragoza (De Miguel 2014). As main feature there is unevenness between one of its crossing streets (Don Jaime I) and the rest, it has been solved with an elevated, flat platform, accessing to it from the street by two of the edges, using a ramp on one side and stairs on the other. The unevenness that is produced, of approximately 1.50 m is absorbed visually with the creation of an inclined wall with a water layer, visible from calle Don Jaime, at low elevation, leaving the upper platform, flat and free of obstacles freeing its center, with the high point of view (see Fig. 3).

Two consolidated spaces with different characteristics, both in the inclusion of urban furniture and in its base of support. One (Santa Cruz) with intention of filling with elements in its center (parterre, trees, pergola, etc.) and flat base, and the other (Ariño) with empty center and concentration of various elements on its sides (banks, three trees of small size, access ladders, access ramp and support wall) and with flat base elevated respect to the street that crosses and divides it.

6 The Realization of the Architecture Students

Parallel to the progression of the practice, students were generating digitally the built volumes and its basic configuration, materialized using 3D printing techniques. It is important to point out this process carried out in parallel in order not to influence the perception of the participants. The built volume, in a simplified way, allows you to appreciate the resulting space in each of the squares. Plaza de Santa Cruz has clear limits and its form, almost orthogonal, along with pedestrian use, gives you a resolution of static space. Although the represented tower is not located

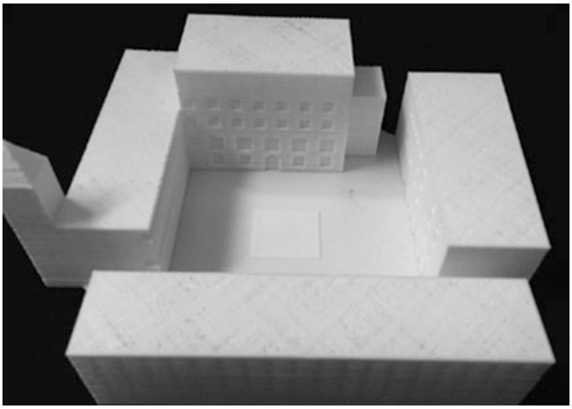

Fig. 4 Model with 3D printing. Plaza Santa Cruz

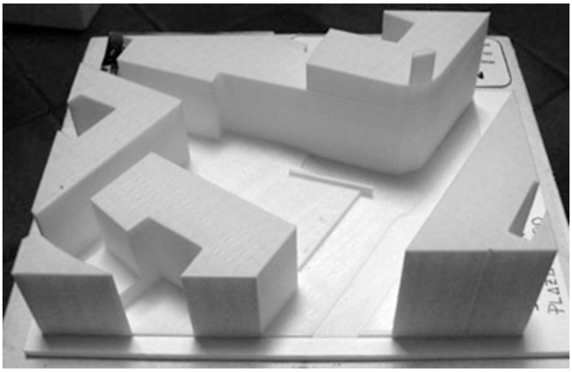

Fig. 5 Scale model with 3D printing. Plaza de Ariño

in the urban area of study, it is included because of the events produced in the development of experimentation, as it will be explained later (see Fig. 4).

The space formed in Plaza Ariño, rectangular square but with less orthogonality, is divided by the unevenness in calle Don Jaime I. It has two distinct uses: the raised platform, only with pedestrian use, and the calle Don Jaime I on a lower level, drawn as a street with sidewalks and driveway for vehicles (see Fig. 5).

7 The Perception and Expression of People with Intellectual Disabilities

These trials of representation, through drawing by hand, start from a premise: the inexistent prior preparation of the participants. Intentionally no one prior learning in design, handling and control space has made. Although it might be of great interest, this research considers very important to analyze the representation of spontaneous perception without any controlled leading. Absolute freedom was allowed in the perspective drawing and positioning in space, with material support that allows the election of any kind of representation. Only, before start drawing, it was allowed a time of viewing and acceptance of the place.

Jaime has chosen initially to draw a volume, being the only element vertical and different: Tower of the Church of the Holy Cross. Although it is outside the area of work, it can be displayed perfectly from various points, but it is always positioned outside the square space. Drawing obtained with the subsequent processes of digitization can be seen in Fig. 6.

Other fact very surprising has been the intrusion of a motorist at the pedestrian level. While they were drawing, a person on a motorbike has gone through the square, riding around the perimeter since the central space is occupied, up to a certain point, parking it next to a wall. The movement has been circular. Jaime has been observing a dynamic element in a static space and he has concentrated on representing it. The result has been a movement, a tour, a time, a tour of spacetime (see Fig. 7). Then he followed drawing other elements such as the central street and some of the larger trees.

Sergio at all times has been drawing elements of urban furniture: a lamppost, a tree, pergola, the parterre of lawn green and rectangular, etc. without paying attention to the delimiting planes. Logically all the drawings have been flat, with some attempt of Sergio in using perspective, given its non-existent formation. Color has been another element that they have taken into account. Color is not necessarily linked to the reality but as a way to reinforce and fill the figure.

In Plaza Ariño, Jonathan has tried to express the existing unevenness from the low level in calle Don Jaime I breaking down it, just like the buildings that can be

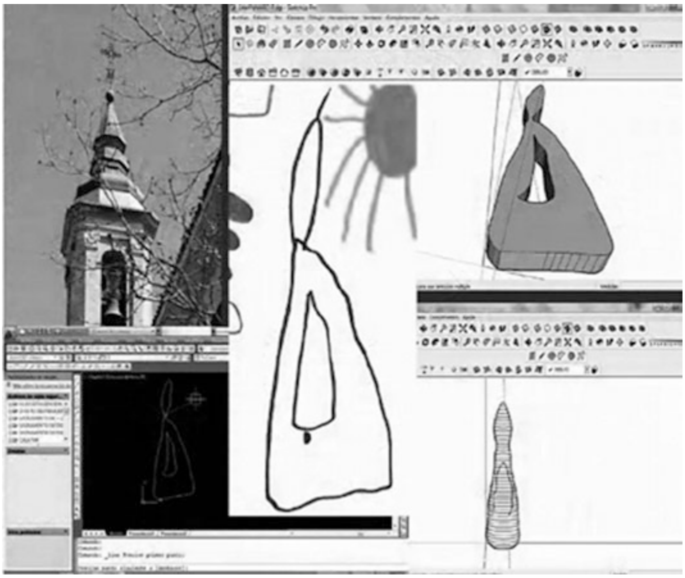

Fig. 6 Representation of drawing in Plaza Santa Cruz

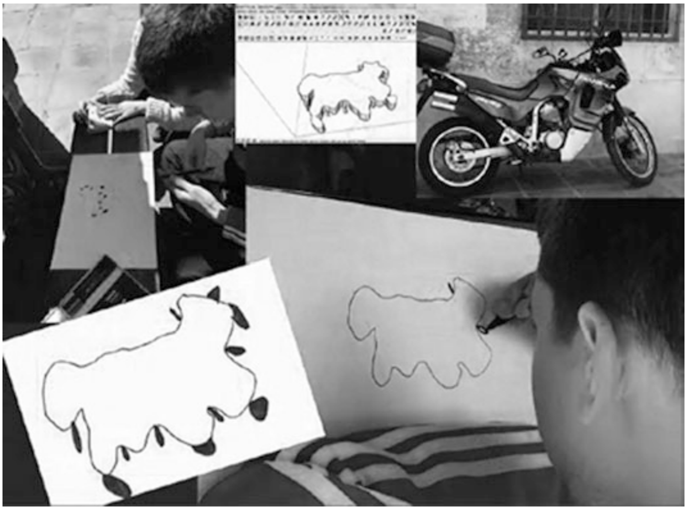

Fig. 7 Drawing of a moving element in the plaza of Santa Cruz

seen frontally. Drawings of downed planes filled with circles (window shaft). The elements that are different from the downed planes are the sculpture situated in the center and signs related to commercial offices.

Just as surprising were the drawings of Andres. Although the configuration of the square is formed by planes that constitute it and delimit perfectly, it can be seen in buildings a composition of vertical volumes formed by bay windows, protrusions and balconies which aligned and close each other, form "vertical planes" in almost all of its facades. He has expressed this fact by drawing vertical slender planes. The definition of isolated vertical planes is complemented with the writing of the posters of commercial applications (see Fig. 8). The empty space of the square, in this case, allowed a greater and better look towards the architecture and, of course, as in the other square, to accessories and variable elements.

8 The Interpretation of Architecture Students by "Cognitive Scale Models"

The expression and graphic representation made by people with DI has been interpreted by students through the so-called "cognitive scale models". Drawings have been digitized giving to the objects significant volumes. Finally, there has been made a 3D printing, in the same way as the volumetric scale models, thus achieving a way to represent, capture and touch the look and expression of the authors, getting a perceptive, physical and understandable result. The expression of the vertical planes of plaza Ariño is volumetrically interpreted in Fig. 9, defining the three different parts in the drawing as they are the base, the vertical element and the ending.

Fig. 8 Drawing of Andres in Plaza Ariño

Fig. 9 Interpretation of the vertical planes in Plaza de Ariño

Fig. 10 Interpretation of the diferent objects and drawn elements in the plaza of Santa Cruz

Some of the different objects and drawn elements have been treated individually, as they have been perceived and drawn (Tower, tree, lamppost of four arms, movement of the motorbike, etc.) and printed in 3D getting a "collage" of events arising out of the place itself (see Fig. 10).

9 Conclusions

– These tests, in this teaching experience, have allowed to highlight new paths of reflection about teaching in architecture, linked to the society, producing different lines of research in the perception of the public space. This trial has been carried out with a vulnerable society sector, such as intellectual disability, and may be applied not only to persons with perceptual and cognitive limitations but all citizens.
– The use of graphic expression, in different ways, and as a tool, can reflect and confirm the existence of different forms of perceiving the public space.
– The society is complex and diverse and it is necessary to accept, understand and bet on the integration and inclusion of all sectors that form it in the understanding and use of public space, since it is and it should be of use for everyone.
– Translation and interpretation by digital instruments and current technological advances, materialized in "cognitive scale models" enable objective, tangible and measurable results, opening up new ways of understanding and support to people with cognitive difficulties and communication. These trials are the beginning to further research on the sector DI, and must go on evaluating other differentiated profiles.
– The consolidated public space, tested in these two squares, has been questioned and, in these cases, it was realized a greater interest in the less permanent elements. Changing and mutable objects interact better with users participating.

Mentioned behaviors of the contemporary city may be more linked to the platform of movement, being persons and objects that are there more participatory actors.

- The permanent planes, produced by the buildings, are useful as "space activities". The facades of these spaces behave as backdrops.
- Architecture that shapes the spaces should produce greater communication with users and should therefore have a greater capacity for change. The vertical planes only mutate on its lower fl with their commercial alterations. The ability of transformation of the rest to be able to perceive in a different way might be questioned.
- Expression, translation and interpretation of public spaces made in this investigation, points toward a distance among the purposes pursued by the design of urban space and the ones accepted by today's society, without any exclusion. And therefore it points to new ways to solve the public spaces of cities for all its citizens.

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Teaching Strategies for the BIM Work Process

Luis Agustín Hernández, Angélica Fernández-Morales and Miguel Sancho Mir

Abstract At the University of Zaragoza we have taught, for six years now, a subject on BIM called EGA 5. Despite the good results obtained so far, we believe in continuous improvement and thus this communication is based on the analysis of other international teaching experiences made with BIM. Among other things, we found that successful experiences are based on collaboration at various levels, and that the teaching of BIM should be started at the beginning of architectural education. Translating this analysis to our case, we have outlined possible strategies to apply in the future.

Keywords BIM · 3D · Collaboration

1 The EGA 5 Subject

The content of this communication arises out of the experience in one subject "Graphic Architectural Expression 5" (EGA 5—*Expresión Gráfica Arquitectónica 5*) delivered in the fourth semester of the Architecture Degree at Zaragoza University. At the time this text was written the subject has been taught for six years (seven at the time of publication in reports).

Right from the start the aim of the subject was to provide students with the necessary knowledge to be able to effectively and rigorously use a number of computer tools for architectural representation, which increasingly prevail in this field: those encompassed in the BIM category. More specifically the subject to date

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has always worked with the *Archicad* tool, complemented in the final stages by the tool *Artlantis*.

As mentioned previously, the subject is delivered during the fourth semester of the degree: during this phase students' knowledge about construction, structures and installations is still rather limited. Therefore, despite the huge potential of BIM in this aspects—as discussed later on, we try to focus the tool towards defining formal, volumetric and material aspects of buildings, keeping it at a basic project level and trying to extract all the expressive potential from the chosen tool.

The subject is eminently practical and employs a teaching methodology based on active, cooperative learning by students through three models: participative lectures (De la Cruz 2004), autonomous work and collaborative work. The sessions are structured initially in the participative lecture with the objective of explaining the working philosophy and the necessary notions to manage the software autonomously, a synopsis of these notions will be provided to students in an educational platform which will serve as a virtual method of connection between the lecturer and the student. During this stage students not only benefit from observational learning, but they are also provided a computer for participative follow-up of the explanation. The second part of each session is based on autonomous and collaborative work by students. Autonomous work is guided through individual practical approaches that help with assimilation of concepts and the procedures explained by the lecturer. These practicals are presented as short pieces of work delivered weekly. The stage involving collaborative work takes place over a longer period, establishing a final group project with groups of 2 or 3 students, which is carried out over the semester. Student assessment is based on the results of the final project in which they must prove the competences they have acquired, with correct performance of individual practicum being compulsory in order to opt for said assessment.

This is so that by the end of the subject students should be capable of making a complete virtual model of a building, with geometrical accuracy and defining the basic components (site, walls, floor structure, doors and windows, etc.), and to properly produce the graphic documents defining the building in two and three dimensions, in addition to producing lifelike images. Each of these basic competences is assigned a specific weight within the syllabus of the subject, which pertains to the percentage of it in the assessment.

In the subject teaching guide (Zaragoza University 2015) the following learning objectives are included:

– Students should be familiar with and know how to use the computer tools available today in the field of architectural representation in a comprehensive manner and optimising compatibility between different programs.
– Students should be sufficiently knowledgeable to be able to choose the best tools for their preferences in their future studies and profession, that best adapts to the way they work of the specific requirements of each project.
– Students should understand the implications of using software tools in the work as architects and how to make the most out of them.

Fig. 1 Huelva bus station. Work by Mario Artieda, Adrián Bes and Luis Lastres

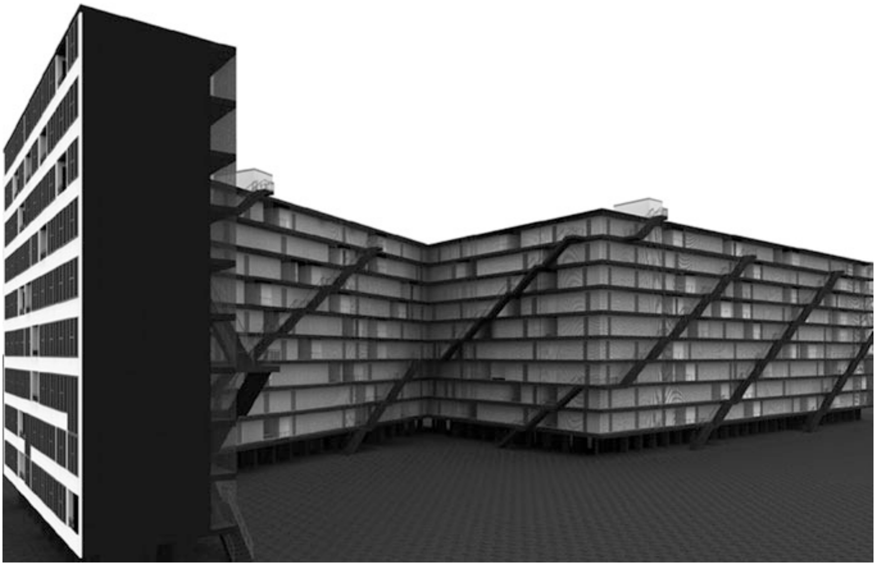

Fig. 2 Gifu, Kitagata apartment building. Work by Daniel and David de Buen

This means that, more than rapidly training and instructing them in managing certain tools, what is pursued is for students to learn to be autonomous and acquire their own criteria in the use of software resources. As for the work load involved in

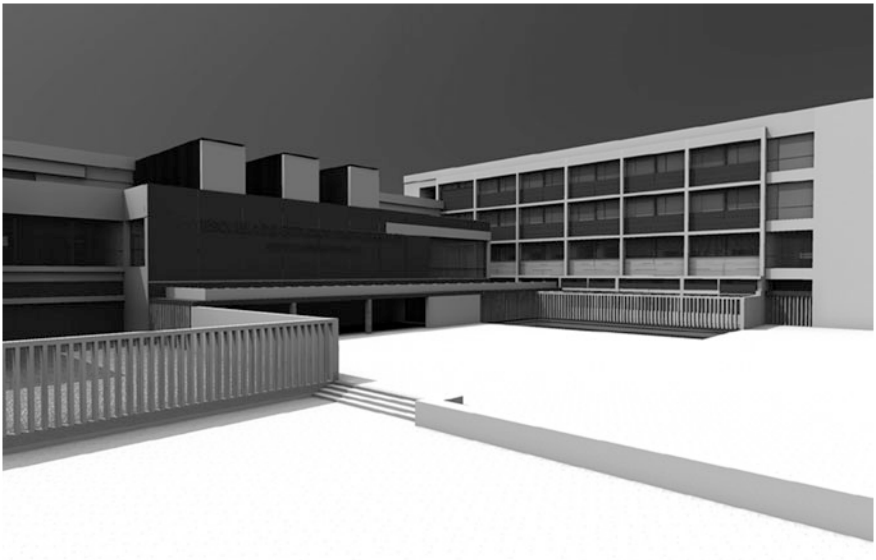

Fig. 3 Lorenzo Normante building, Zaragoza. Work by Beatriz Nitulescu and Diego Valenzuela

the subject, the objective is for students to make the most of their time in the lecture room, although the 6 ECTS assigned to the subject will require additional time spent on the subject outside lecture hours.

Every year for course work, a different theme or building type is chosen. Each group develops a different building, with a level of formal and constructive complexity that should be equivalent. This methods permits furthering students' knowledge on specific types of architecture, trying to delve deeper into the transversal natural that academic training requires. To date work has been carried out on stations (Fig. 1); collective housing (Fig. 2); university buildings (Fig. 3) and cultural buildings (Fig. 4). During the selection process the aim is for projects to have sufficient formal and programmatic complexity since students are in their fourth semester and are ready to take on this challenge, as they have already worked in depth with minor programmes, such as detached houses and small scale buildings in previous subjects.

2 The BIM Process

The acronym BIM is indistinctly used to denote *Building Information Modelling* and *Building Information Management*. The second term, covering a wider scope, is actually a better definition of the term, although it is more correct to talk about BIM(M) (*Building Information Modelling and Management*) (Barnes and Davies 2014).

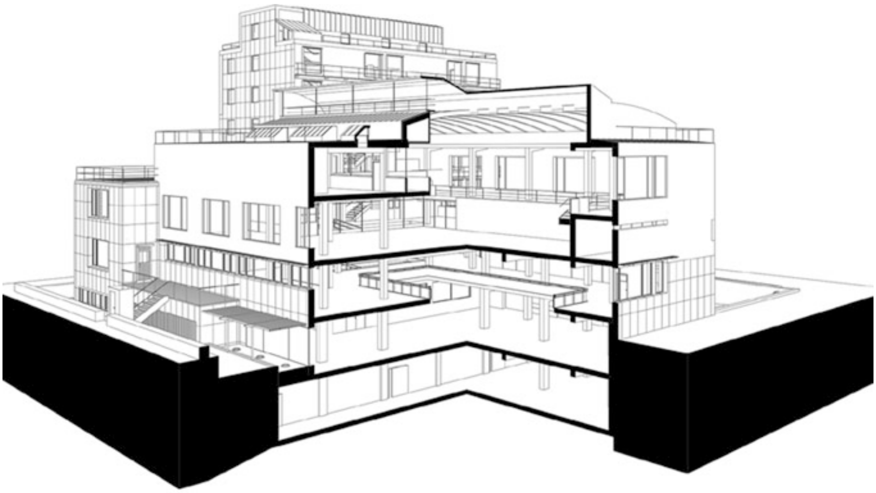

Fig. 4 Aragon library, Zaragoza. Work by Aitor Gutiérrez, César Jimenez and Siddharta Rodrigo

There is agreement in many texts about BIM defining it as a *process*. *Autodesk*, which has taken the task of becoming leader (also) in this technology, gives the following definition on their website: "BIM is an intelligent model-based process that provides insight to help you plan, design, construct, and manage buildings and infrastructure" (Autodesk 2015).

Barnes and Davies (2014) place more emphasis on control of the physical and functional performance of a virtual building: "BIM is a computerised process that is used to design, understand and demonstrate the key physical and functional characteristics of a building (or a construction or civil engineering project) on a virtual computerised model basis".

Considering these definitions it is important to bear in mind that BIM is not only applicable to the design and construction phases of a building, but also to the rest of a building's lifecycle or that of a civil engineering project, hence the term *process* makes more sense. These definitions also make it clear that a BIM model is not only a three-dimensional model, but rather is a model of information at many more levels, with the geometric information being just a part of it.

For the geometric side of things however, which is the part this subject is mostly concerned with, the BIM tools, and particularly *Archicad*, also have interesting advantages over other 3D tools commonly employed by architects and architecture students, such as *Rhinoceros*, *Sketchup* or *3DStudio*.

These advantages include:

- a large database featuring pre-designed objects with constructive definitions (doors, windows, walls, roofs, staircases…).
- information is automatically organised in storeys and flats.

- the views and plans of the model are produced automatically, with many options when adjusting the appearance.
- it permits simple creation in just a few steps of very visually effective graphical documents, such as cross-section views, cone perspectives, shaded views, etc.
- automatically applies all design changes to the affected views.
- facilitates teamwork, permitting simultaneous editing of several parts of the same model in network.

Basically it is considered to be better adapted to the specific needs of architectural work than the other tools that have been mentioned, which are very powerful from a geometric point of view, but more generic in application. These advantages, but particularly those associated with control of constructive, structural, energy, costs, organisation, regulations, etc., aspects make this technology today, and more so in the near future due to its rapid evolution and improvement, a *sine qua non* in professional architecture. It is therefore a must in the teaching syllabus of architectural studies.

3 BIM Teaching Exploration at International Level

In order to define teaching strategies for the BIM process we started by establishing a status of the question: i.e. browsing articles, congress papers, books, etc. related to this subject in the field of teaching architecture or design, which have had a certain degree of academic impact at national and international level.

To conduct this search for information, we resorted to the databases of *Web of Science* and *Scopus*, since they are considered the most highly rated in terms of scientific quality. The search in Spanish for the terms "*docencia BIM*" and "*enseñanza BIM*" in those databases did not report any matches. We therefore resorted to searches in English "teaching BIM" and found several publications. 42 in *Web of Science* and 9 in *Scopus*. All of them were associated with foreign universities, and we are therefore able to assert that today there are no articles by Spanish authors.

We have worked with two types of papers.

1. Texts that describe teaching experiences carried out in international university contexts associated with BIM technology. These included work by Gu and De Vries (2012) at Newcastle University (Australia) and Eindhoven; Herrmann et al. (2014) at Mississippi University; Ibrahim (2014), Abu Dhabi University; Lv, Huang and Zou, Hubei University (China); Nakapan (2015) Rangsit University, Thailand; Ren and Zhang (2014), Liaoning University (China); Zhao et al. (2013), Virginia University; and Ruschel Andrade and Morais (2013) with a diagnosis of several teaching experiences in Brazil.
2. Theoretic texts or reviews which, without describing the specific experiences undertaken, they do lay out proposals, trends and/or give guidelines about how

to proceed when teaching BIM. These texts include: by Ambrose, an American author of reference on the use of digital media in architectural production and training of 2007, where he announces a change of paradigm in design methods; by Barison and Santos (2010) where they establish subject categories based on BIM depending on the level and activities performed by students to include in the architecture syllabus; and by Cimino (2013) which discusses the change in teaching that substitutes the traditional approach to design for a novel BIM based approach, and puts emphasis on better adaptation by students to the demands of the job market.

We outline the main ideas extracted from those texts as follows:

1. Asia is at the forefront of BIM teaching. The predominance of recently created universities and schools probably contributes to this fact: young teachers fully immersed in the digital culture; syllabuses in which new technologies are included from the start; new facilities with latest generation IT equipment… Secondly, and most probably somewhat more senior, is the importance of BIM implementation in the United States, and to a lesser extent also with BIM presence in European and Australian universities.
2. Collaboration is perceived as one of the biggest potentials and most important aspects of BIM teaching. Most teaching experiences are based on this idea. Collaboration takes place at different levels, all of which have reported successful experiences:

   – Among students, forming work teams (Zhao et al. 2013; Gu and de Vries 2012). These teams could feature a coordinator or BIM manager and the use of servers to share information is fundamental.
   – Among the subjects in the same degree, basically combining a graphic expression subject with a project, architectural design (Lv et al. 2013) or with a technology subject such as construction (Gu and de Vries 2012).
   – Among students on different courses, when BIM is included from an early stage is the studies (Nakapan 2015).
   – At inter-disciplinary level, through collaboration by architecture students with students in other fields (engineering, interior design, graphic design) (Hermann et al. 2015; Gu and de Vries 2012).
   – With businesses outside academia, for example the construction industry, who are involved in students' projects and add to them with talks, workshops, etc. (Zhao et al. 2013).

3. It is much more effective and motivating for students to relate BIM teaching with subjects or exercises in the form of projects, than delivering the subject as simply managing the tool (Nakapan 2015). This can be done either by integrating BIM in project subjects or setting out subject titles such as the development of proposals for a ideas competition (Hermann et al. 2015).
4. BIM teaching acquires different roles and approaches depending on how it is fitted into the syllabus. In introductory courses, BIM is mainly used for

three-dimensional modelling. In intermediate courses it can be used as support for design and also as an analysis tool (structural, costs, etc.); whereas in advanced courses BIM permits comprehensive works direction and management (Ruschel et al. 2013, based on the model by Barison and Santos 2010).

5. It is thought to be better to introduce students to the BIM process from the second semester of their studies, rather than waiting for them to reach higher levels (Nakapan 2015; Ibrahim 2014). It can be argued that having first learned to use a CAD tool or a very loose 3D modelling tool, such as Sketchup, can be an obstacle when trying to gain command of BIM philosophy, which works on the basis of predefined objects and where rigour in dimensions, unions, etc., is much more important, more similar to real life construction (Ibrahim 2014: 428).
6. In several cases the idea of teaching BIM is associated with the idea of training students in IPD (*Integrated Project Delivery*), considered to be a competence with increasing demand on the job market (Hermann et al. 2015; Ruschel et al. 2013).
7. Since BIM is not just a tool, but rather a working methodology, teaching architecture through BIM is *not the same* as using traditional methods to teach it: applied pedagogy and learning acquired by students are not the same. Different authors defend the advantages of using BIM over other educational methods (Ambrose 2007; Cimino 2013). Studies carried out through surveys and interviews with students and teachers (Ren and Zhang 2014) seem to reveal that teaching through BIM is more effective than traditional teaching methods of architecture, and also suggest therefore, that BIM plays a more important role in university eduction in this discipline.
8. Two commercial tools crop up several ties in the different texts: *Archicad* and *Revit*. The second appears to be preferred by students, according to the surveys (Ren and Zhang 2014). Other names are hardly mentioned.
9. Assessing students in BIM teaching is a question that has not been addressed in the papers. The doubt therefore remains in this is because they have not given importance to it or because it is not tackled any differently from other subjects or work, or that it has not yet been resolved to any degree of satisfaction to be able to define it in a paper.

4 Learning Results in the Subject EGA 5 and Proposals for the Future

In view of experience over six years teaching BIM at Zaragoza University, we are able to claim that the results to date have been positive, basing this statement on three verifications:

– The number of students who pass the subject, and therefore the proportion of students who successfully acquire the expected knowledge and competences is high.
– Students' opinions about the subject, as recorded in the assessment surveys conducted by the University, are good.
– The quality of the work delivered by students at the end of the subject is high, from a graphic and constructive point of view.

Nevertheless, we are aware of some shortcomings that we need to address, mainly in terms of the model applied to collaborative work, where we should avoid teamwork becoming a simple distribution of tasks among the members of the team to pass the subject, and in terms of motivating students to use BIM on a more permanent basis.

By reviewing teaching experiences carried out by others, we have seen the long road ahead of us, and the diversity of actions that we need to carry out to position ourselves at a level that is comparable to the examples seen. In our specific case, applying these experiences would come up against a number of Difficulties and Threats, but also some Strengths and Opportunities (Table 1).

Considering this scenario, we are led to believe that the improvements to be implemented could basically go in two directions:

1. To encourage collaboration with other subjects and materials and with external companies. Internally we believe collaboration with subjects in other areas of technology such as construction is viable and effective, which are also present in

Table 1 SWOT analysis of the architectural graphic expression 5 subject

Difficulties/Threats	Strengths/Weaknesses
– The competences assigned to the different Fields of Knowledge are not very permeable – The interest and willingness by in the field of knowledge of design by teachers with BIM is somewhat limited – The credits assigned through EGA to BIM teaching are limited and are only in one semester of the study period – The obligation of defining organisational aspects for the subject in a teaching guide beforehand entails difficulties when planning new, last-minute proposals, changing strategies – Motivation and enthusiasm by students towards BIM during the semester, although acceptable, allow room for improvement – Continued use of BIM by students after finishing the subject is low, with the use of traditional 2D and 3D CAD tools predominating	– The syllabus is new and integration of new technologies is considered in the contents – The interest and willingness by professors in the area of BIM teaching are high – The interest and willingness in the areas of technological knowledge through BIM teaching are high – Carrying out occasional cooperation work with other subjects and other courses is viable – Carrying out occasional cooperation work with external companies is viable – The most common commercially available tools provide free licences for students – The learning capacity and effort by the students are excellent

more advanced courses, which would enable us to work with more highly trained students and achieve higher degrees of qualification. Nevertheless, with a view to motivating students and achieving a culture of using BIM tools during the rest of their academic education, it would be a good idea to encourage collaboration with project-based areas. Perhaps the teachers in the field of Graphic Expression need to adopt the role of "awareness makers" or drivers, among our colleagues in other fields of knowledge concerning the advantages of including the BIM process in the entire syllabus.

Externally, i.e. in terms of collaborating with companies external to academia, there are many possibilities, which not only involve them listening to our suggestions, but also us listening to their proposals.

2. Boosting motivation and involvement by students. In this sense each year we could introduce new exercises with defined duration and assess the perceived response. Some will work better than others, although the question is to see where there is greater involvement and a more positive response. Another possibility is to promote a more proactive roles among students. In this sense we could try the figure of team coordinator or BIM Manager, or alternatively assign tasks that entail students taking on individual responsibilities.

Introducing announcements for projects could however be the most effective option to achieve higher motivation right from the early weeks in the semester, rather than increasing motivation through to the final stages of the subject, as is currently the case.

5 Conclusions

The different authors we consulted agree that the idea of BIM teaching will have an influence on the possibilities of our students adapting to the demands of the professional world when they complete their studies. This way we should not only try to contemplate BIM within our own teaching syllabus, as has been done in many cases, but we should also research further into more teaching methodologies that are more appropriate to make assimilation of the competences as effective, complete and realistic as possible, exploring the specific opportunities afforded by this new technology that transversally encompasses architectural projects.

Observing and analysing experiences at other schools is useful to obtain ideas and avoid errors, and therefore disseminating our own experiences is also our responsibility.

The valid assessment criteria for subjects based on BIM must be dealt with thoroughly, because of the singularity and depth of the work process, understanding assessment as a fundamental part of the learning process. This way, which is necessary to contemplate in a balanced way, the different competences acquired vary substantially, both at curricular level of students and specific objectives defined, thus conferring more weight to one or another depending on orientation, whether more graphic, more design or more technological, within the subject. In a subject in the Architectural Graphic Design field, obviously the first of them will always have a higher specific weight, but we should not forget that BIM is not only a representation tool, but is more a global work tool in architecture.

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The Laboratory of Representation in the XXI Century, from the Study of Geometry to 3D Printing. Perspectives and Innovatively Coordinated Methodological Devices for an Experimental Teaching

Rita Valenti, Sebastiano Giuliano and Emanuela Paternò

Abstract The purpose of the research is to explore since the beginning of the cognitive approach the potentialities offered by drawing, starting from the free hand drawing to tackle those offered by the new information technologies especially in relation to the visual and tactile communication, considering also the continuous refinements in the interrelated processes between modeling and mathematical models. The proposed task, synthesis between learning methodology and applied research, is the expression of the continuous evolution and transformation of the teaching approach strategies, of the methodologies and technologies in order to guarantee a rigorous answer to the education requirements, through the detection of more and more appropriate and suitable solutions for the different needs and learning styles.

Keywords Descriptive geometry · Architectural orders · 3D modeling

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1 Fundamental Teaching Paths: Experimentation and Applied Technological Innovation

R. Valenti

"Our job is therefore to invent a new system of education that may lead—by way of a new kind of specialized teaching of science and technology—to a complete knowledge of human needs and a universal awareness of them." W. Gropius, Prospectus of the Bauhaus at Weimar.

Today more than ever it is possible to understand how these words are strongly connected with the increasing scientific and technical innovations which place teachers in a new position regarding the specific paths of the representation studies.

The education system of the XXI century is undergoing dramatic transformations which require the development of a paradigm shift and of new methodological approaches, referring in particular to the growing attention on the analysis of the learning methods, of personalized educational offer and of the diffusion of active learning solutions through the integrated use of the new technologies.

According to the specific way of understanding the systematic development concerning the new training structures, the methodological innovation, in its most dynamic and innovative meaning, is combined with the innovative practices in such a way as to provide the systematic development of the new learning skills with particular attention to the structure of the morphological evolution of the potential ideas, to the experimentation and implementation of approach methodologies aiming at the fundamental theoretical knowledge supported by the critical and fully aware elaboration through the technological instruments.

In the present context, education, which represents the "instrument" to manage the ongoing changing processes, plays an impressive role; in this sense, the research in teaching methodologies supported by the appropriate and suitable technologies implements the process of knowledge organization, of the circulation of ideas, of exchanging experiences, of content production and learning support.

The experimentation in the field of the "representation" methodology, for its specific features, basically represents a priority for the purposes of *docere et delectare* that is building pleasant learning environments in order to involve the students of the first year in the Architecture degree course in the study of a subject whose evolution of expressive techniques triggers a constructive debate on how to make and prefigure shapes.

Deepening the understanding from the "modus", the way indicated by the science of representation, to the present instruments involved in the representation of architecture through technologically innovative software and systems, the final goal of making the learners master, since the beginning, the visual and tangible communication tool, in all its facets, from the traditional to the most innovative ones, could be achieved. In that way, the concrete activity conducted in the Laboratory of Representation leads to the proper understanding of the real potentialities and conveniences of the different undertaken approaches.

Modern technology is then perceived not as a privileged instrument but as an instrument to be used according to the expressive needs and with the gnosiological support of geometry. The computer introduces us in the complex dimension of the methodological process; complex but semiologically similar to geometry, the only real science which allows freedom of expression to be consciously transmuted into formal reality.

2 Geometry as the Pillar of the Teaching Experimentation Process

R. Valenti

The exceptional ability of geometry, from the Euclidean one to the most recent fractals and geometric topology, to comprehend, control and describe shapes in space, allows a methodological study approach according to which, with the support of dedicated computer technology and with the specific support of digital modeling and 3D printing, expressive possibilities are arranged as in an experimentation field.

Aware of how the methodological potentialities and basic assessment of Drawing are strongly structured, the attention on technology, since the first steps in the world of geometry, improves their abilities in the double form of cognitive support on the one hand and representational *amusement*, consciously used, on the other.

The main task of teachers is that of educating students who begin their studies at the School of Architecture; training must be considered as a strong desire to fill up with enthusiasm and passion any activity they are engaged in, combining the basic skills: *firmitas*, the stability of the educational approach with the sense of mandatory urgency towards scientific knowledge, *utilitas*, the utility with the sense of expressive ability and organization of the communication of ideas, *venustas,* the beauty of the teaching project (Fig. 1).

The proposed work, synthesis of teaching methodology and applied research, is the expression of an evolution and of the constant change of approach strategies and of methodologies in order to guarantee a precise answer to training requirements, through the identification of more and more accurate and suitable solutions for the different needs and learning styles.

In particular, as for the topics regarding the Representation class they are dealt with following a procedure which starts from the traditional freehand geometrical drawing and converges into the elaboration of 3D printing, moving from the study of the same shapes through their plastic and digital modeling.

The strict connection between geometrical drawing, digital model and physical model, since the first codified constructions of geometry and architecture, implements in the learner's mind the skills of plastic configuration of the studied shapes, developing a method to approach the solution of design problems, strongly correlated with the process of intellectual and scientific elaboration.

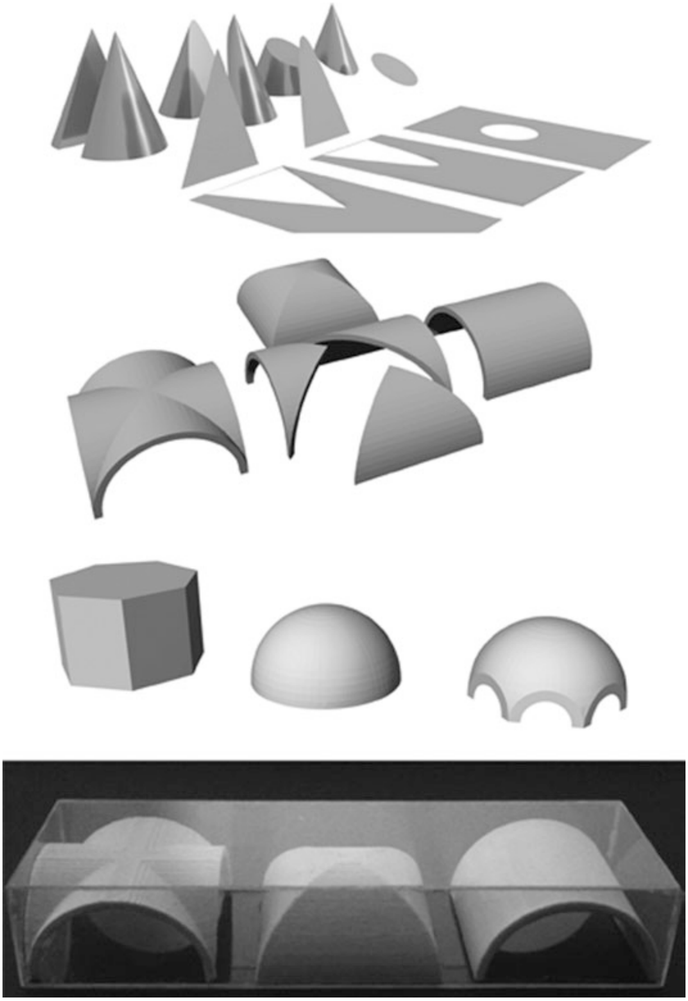

Fig. 1 3D elaborations and 3D printing of conic sections and vaults

Architecture in its making actually is an open dialogue between what we want to achieve and what still structurally exists in the form of idea, between what we have been trained at and the new knowledge connected to the very instant we conceive our stream of thoughts, between creative freedom and rational coercion. The complexity of architectural objects, along the methodological process, is gradually unveiled through digital simulation, with a simplifying approach which makes Euclidean Geometry the expressive term of reference.

The graphic and plastic process of the analytical approach is governed by the principles of geometry; the current use of the computer as a means of expression becomes a necessary consequence. The aim is to make learners consciously master the digital and physical representation and modeling techniques as a basic prerequisite for an appropriate control of the work done; the main purpose is to create designers able to operate the tools and not simply to use them.

Only a scientifically supported approach can transform the simple users of the software proposed by technology into agents with the expressive and interpretative skills which technology itself can offer if properly used.

Therefore, the catalogue of exercises carried out in the Foundations of the Representation Course within the ambit of the Laboratory of Architectural Design 1, concerning the basic geometry of Euclidean solids and geometry of the fundamental elements of architectural construction, stirs students to explore different routes in order to evaluate the narrative skills in terms of perception and representative utility.

Thanks to the possibilities offered by 3D printing, data transmission, from the common digital model to the 3D manufactured model, brings back the natural and traditional way of designing, evaluating and exhibiting the idea.

«For the architect the world of thoughts, ideas, fantasy and invention is always connected to the material world. In this correlation all the potential of architecture is to be found. Despite all the possibilities offered by virtual manufacturing techniques and drawing, it is the architectural model which best expresses this correlation.»[1]

Technological innovation conveys the necessity to postulate the past as still part of the present assimilating and making it manageable not according to the historical knowledge but rather according to the real experiential dimension, always at the basis of the creative process.

This learning and educational approach represents a kind of reconstruction of what is somehow lost with modernity; it is as if through technology there was a return to traditional methodologies, activities done no more by a craftsman but through instrumental skills and meant as a way, a *medium*, for the reasoned representation of purely geometric solids or of historical and contemporary architectural scenarios. The complete management of the generation of shapes of the architect's world, and its dedicated software, discloses an expressive immersive ability in the communicative space, which accompanies the virtual one typical of the screen and of its initial reference.

Owing to its communicative purposes, each relation between signified and signifier is conceptualized as a structured connection with the graphic course of study, made with pencil or digitally, where the sequential logic can be expressed in different ways for each student, provided s/he can orientate her/himself correctly.

In such a way it is possible to provided an educational opportunity between teaching methodology and experimentation where the recognition of the founding theory, based on the principles of descriptive Geometry and of the possibilities offered by the most modern equipment supplied by the Laboratory of Representation, represents the pillar of a teaching style according to the present demands.

[1]Next. 8. International Architecture Exhibition, National Participations, *Germania,* Venezia 2002, p. 58.

3 For a 3D Teaching Approach: The Architectural Orders

S. Giuliano

The study and understanding of the architectural orders have always characterized the early stages of learning at the Architecture School. It is inconceivable, in fact, to approach the historical heritage without studying, understanding and analyzing the particular sequence of moldings which characterizes the architectural order at its structural, functional and decorative levels.

The Vitruvian "triad", as a moment of analytical distribution of the historical heritage, promotes a type of architecture which looks at the past, adopting the principles of construction and reinterpreting them through an evolution of design every architect nowadays should take up.

The drawing of architecture, in such a way, becomes a vehicle to spread awareness. Drawing requires, in fact, the possession of a big knowledge about what is to be represented, a rigorous knowledge directly proportional to the representation scale which from the construction aspects passes through the functional ones so to arrive at decoration as the natural evolution of the architectural system. The Treatises on Architecture, precious jewels of the Theory of Architecture, which from Vitruvius's prose pass through Vignola's, Serlio's, Palladio's sketches, are a privileged means for the study of the architectural order.

The teaching method regarding the drawing of architectural order constantly refers to the XV and XVI century treatises. Sketches engraved on knowledge-rich tables which involve architecture in its making and which always include the theory of the architectural order.

The diachronic link of these treatises with the methods of representation implies that they have to be represented in the double dimension or in perspective. If two dimensional representation ensured an objective perception of the architectural work, with the limit of the denied third dimension, perspective allowed the simultaneous reading of the three dimensions, endowing the represented work with a specific formal autonomy. Such autonomy certainly was evaluated by the subjectivity of the writer. He, free to set the main parameters of the perspective view, could autonomously enhance a particular aspect of the represented architecture rather than another one.

In opposition to the representative autonomy of perspective and to the limit of the third dimension in two dimensional representations, the new representation methodologies essentially linked to the recent technological development allows, as a matter of fact, a rigorous representation no more affected by the drawer's subjective experience. The virtual model, in such a way, allows the simultaneous reading of the three dimensions; the dynamism of the virtual object not only releases the represented object from the static nature of the drawing on paper it also evokes a tangible response in the observer.

If it is true that drawing means knowing reality in details, it is also true that the simultaneous representation of the three dimensions of reality allows a precise knowledge of what is being represented.

The consequent development of the virtual and mathematical models lies in the material representation of the digital one. 3D printing, in such a way, makes it possible that the tangible response, previously formed in virtual graphics, is delivered to a reality which is no more virtual even if still connected with reality.

Drawing an architectural structure in its two dimensional development, completing it in its 3D development, enjoying it in its virtual dynamism and perceiving it in its tangible response is the experience the students of the second year at the School of Architecture in Siracusa have been involved in. An experience linked to one of the most picturesque places in Eastern Sicily, symbol of the stratified complexity of the island of Ortygia: the Cathedral Square.

The didactic experiment was brought into being by a survey campaign carried out during the research process of the Laboratory of Representation of the University of Catania about the stratifications in the island of Ortygia. The surveys, carried out with laser scanner technology, were centered on the configuration of the different stratification levels in the Cathedral Square: from the hypogean spaces to the baroque curtains of the square.

The students, after approaching the Renaissance treatises on the architectural orders and the point cloud virtual model developed during the survey of the square, were invited to carefully observe the scenery facing the basin with reference to the rules of the architectural orders. The real life drawing sessions of the partitions and of each molding of the buildings in the Cathedral Square—besides educating the students to the appropriate proportioning through the redesigning of the existing—were aimed at drawing the different scansions of the order, distinguishing every single molding and understanding the main construction rules (Figs. 2 and 3).

The second didactic step dealt with the two dimensional drawing of the façades using CAD, from ortho imagery derived from point clouds, meant as a place for confrontation and evaluation of real life drawing and as a starting point for the 3D modeling, final step of the teaching course.

The students had inevitable difficulties in adding the third dimension to the two dimensional papers: in the first instance, the difficulties arose in the management of the 3D modeling software, successfully overcome when the main commands for the representation of solids through the Rhinoceros software were installed to the PC.

Greater was the difficulty in representing the molded structures in their 3D development. Difficulties rarely encountered during the phase of 2D drawing—for reasons intrinsically inherent in the nature of the two dimension drawing—which are highlighted by the third dimension both by the simultaneous views to be represented and by the precise degree required by the virtual mathematical model when in use.

The solution to these problems is often provided by the construction technique of the architectural detail. In particular, the virtual design of the pluralities of the baroque style experienced the same difficulties of real construction; as a

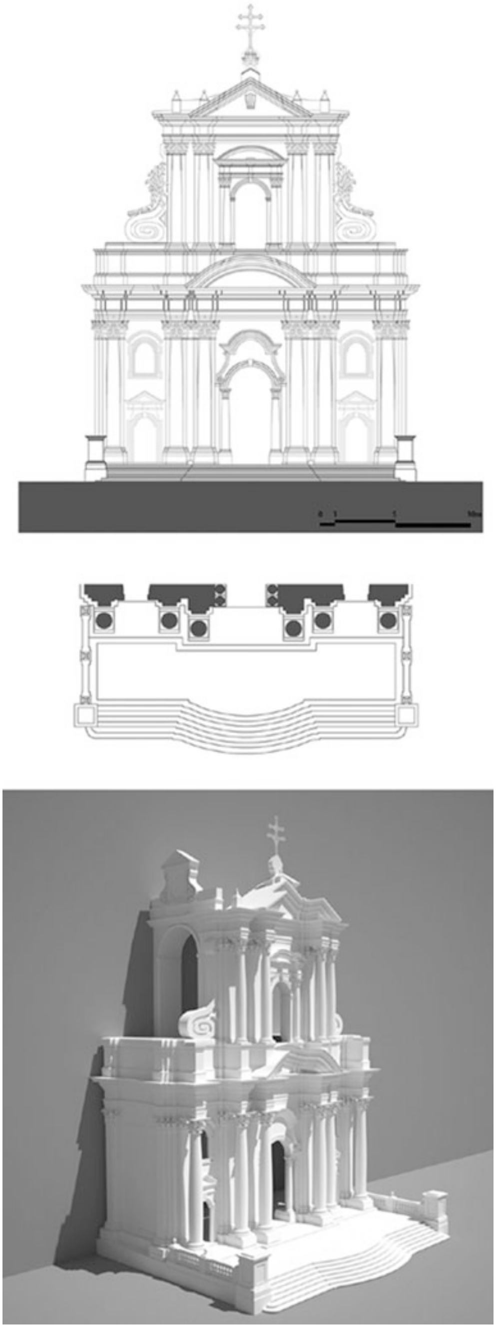

Fig. 2 Survey and digital modeling of the façade of the Cathedral in Siracusa

Fig. 3 Digital modeling and 3D printing: a detail of the Cathedral in Siracusa

consequence the virtual modeling was carried out following the stages of real construction, often attributable to easy manageable geometrical forms.

The third and last step dealt with architectural design communication: on the one hand trying to make real what can be obtained by a virtual model through software suitable to the rendering process and on the other hand trying to materially communicate—through 3D printing—what the virtual design had generated. The rendering process of the modeled façades made possible a series of observations on their plasticity, on the relationships between solids and voids, on the properties of the materials in relation to light and to their exposure.

These are considerations due to the model dynamism which from learning prerequisite border on complexity and research.

4 Thinking in Three Dimensions: 3D Printing

E. Paternò

Representations through plastic models have always been an excellent support for the study of Architecture as well as an effective means of communication to express personal ideas. Although the material representation of any object can provide its tangible perception, however, it is possible only through modeling software to generate dynamic and virtual models able to represent reality with precision.

Thanks to the combination of visible and perceptible, of virtual models and tangible models, recently, a whole series of machinery, among them, 3D printers, have become widespread. They can precisely replicate in the real world any 3D model.

"All the reports on the research about a hypothetical control of artistic expression, whether "design models" or "analytical models" must jointly work towards the High Education of the architect who cannot escape from the cognitive experiences of the "state of the art" situation … through the activation of some exploratory creativity any already made architectural works require unequivocally".[2]

Taking this into consideration, the students of the Foundations of the Representation Course, in collaboration with the Laboratory of Representation, had the first hand experience of what they had already studied in relation to contemporary architecture. After attending a didactic workshop which focused on the topic of digital shape creation and modeling, identifying the basic geometry which generates the volumes, they could synthesize their models through their 3D[3]printing. This process allowed them to develop a deeper understanding of the object itself, from the formal and conceptual point of view. In fact, while the architectural redesign stimulates in the students the content knowledge of the project, the representation of the object of study through the model, on the contrary, helps them to understand architecture effectively and critically (Fig. 4).

In this way, the elaboration of models becomes an important moment for the interpretation of the architectural work. The model makes it possible to analyze, to research shapes, to identify the underlying idea of the project becoming the result of

[2]Cantone U., 2003. *Le alterne vicende del concetto di "modello" nelle tematiche dell'architettura.* In Valenti 2003, p. 165.

[3]The instrument in use at the Laboratory of Representation is a powerwasp 3D printer with CNC cutter and LCD/SD display.

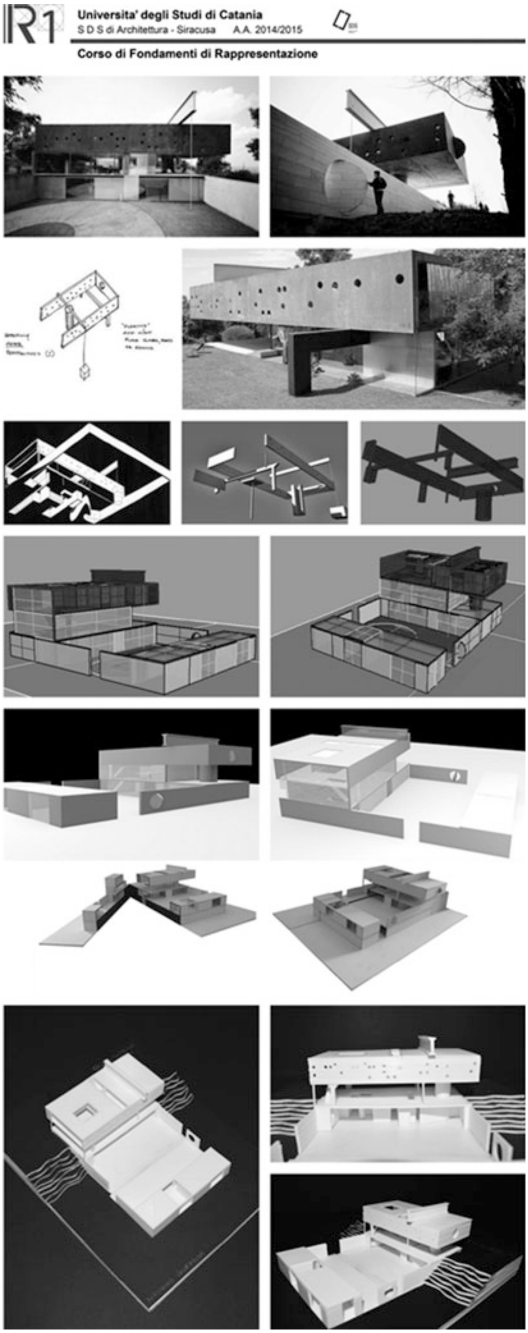

Fig. 4 Rem Koolhaas, maison à Bordeaux, 1998: graphic elaborations, digital model and 3D printing

a constructive dialogue between the teacher and the student. The latter won't be a mere reproducer of plastic forms but their interpreter.

Such a study experience was concluded with the printing of some digital contemporary architectural models which analyzed the concept of living; in particular, Rem Koolhaas' projects in Holten, Holland and in Bordeaux, France suggested to go with the separate printing of the individual floors considering that the building structures are not determined by overlapping levels planimetrically correspondent but, according to the architect's poetic inspiration, by a significant horizontal slipping of the upper floor in the first house and by an articulated composition due to the different altitudes of the site in the second house.

3D printing has been designed so to highlight the distinction between solids and voids and between internal and external voids, expression of an eclectic and apparently dissonant language; specifically the architectural form establishes a dialectical relation between voids, identified by usable spaces and matter, conditioned by exigent demands.

The model, moreover, draws and focuses attention on the architectural elements which make large use of the most innovative technology, never for its own sake, rather instrumentally for the achievement of formal outcomes able to prove how the demands of living, even if conditioned by specific requirements, could be incorporated in pre constructed or substantially free shapes, creating articulated spaces not necessarily structured according to the logic of modern movement itself (Fig. 5).

A further experience of study and 3D printing was the one regarding the model of E. Souto de Moura's patio houses (1999) in Matosinhos (Porto), Portugal. The model makes visible and perceivable the spatial rationality of the project and the research on formal essentiality. The characteristic thematic core of the Portuguese architect's work is, in this case too, that of introspection and enclosure, where the patio's theme, repeated more than once (entrance, central and green patios) is clearly explained in the model thanks to the succession of solids and voids emphasized by the white color of the matter.

The students in the Laboratory of Representation Course 2 proved their skills analyzing the Pavilions of Milan EXPO 2015. In this case, they analyzed the modalities the components of every single pavilion are made up, through a series of inquiries suggested by the work itself. Such a mechanism allows the reading of the construction logic and of the generating forms conferring on the model the role of an interpreter. In fact, disassembling and reassembling it they deepened their knowledge of the project, they understood the construction dynamics, identified the design intentions and brought to light its underlying geometric rules.

As for the UK Pavilion in particular where the model complexity was simplified printing layers of hexagonal meshes (hives) subsequently overlapping and suspending the one with the other so to define the spherical void in the centre which generates its shape, the discovery of the basic rule, symbolic and structural at the same time, was of dramatic importance for the final step of the digital modeling process, that's why the adopted procedure was that of subtracting from the volume represented by the meshes a volume of spherical form.

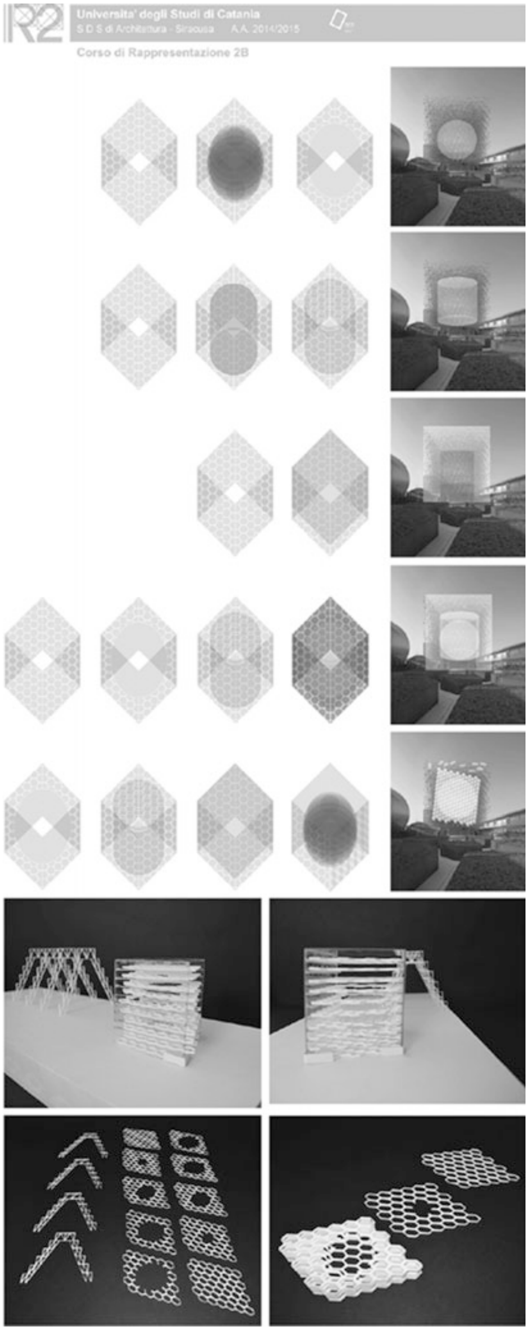

Fig. 5 Geometric analysis and 3D printing of the concept model of the UK Pavilion at Milan EXPO 2015

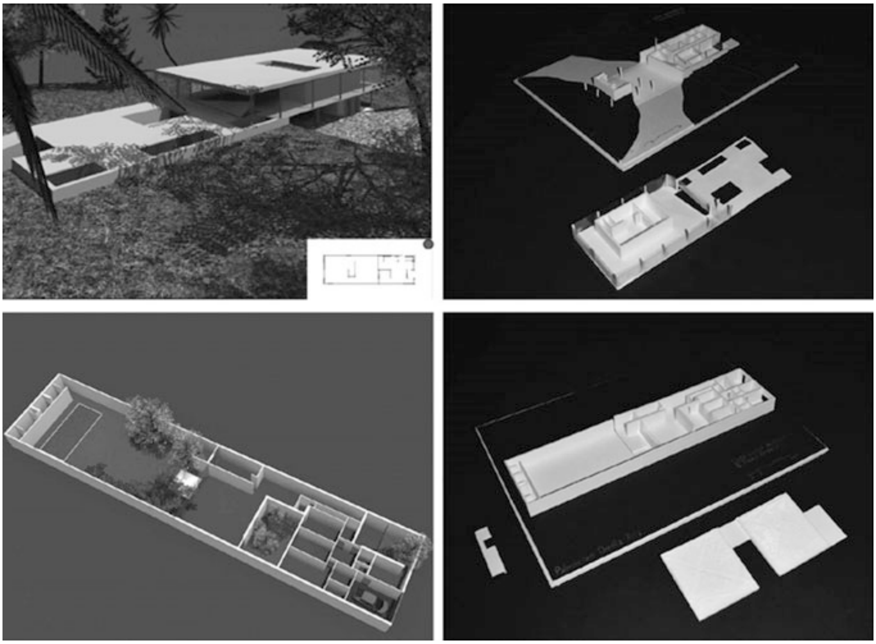

Fig. 6 Rendering process and 3D printing of examples of contemporary architecture

This didactic path[4] allowed the development of a process where 3D printing represents the final phase of a creative path which starts from the idea, goes through its digitization and at last results in physical tangible objects; specifically it proved ideal at raising interest in students, stimulating their creativity. Thanks to the evolution of 3D printing industry, the analytical reasoning on architecture is carried out with "the words of architecture" that is with the instruments and with the language proper to architecture (Fig. 6).

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Configural Containers and Physical Models in Architectural Ideation

Jorge Domingo-Gresa and Carlos L. Marcos

Abstract The necessity to show students a basic grammar of forms in space as a training for future challenges to deal with in architectural design projects is discussed here using abstract referents not directly connected to architecture. This paper addresses a propaedeutic and innovative teaching practice integrated within pedagogic strategies of graphic and three-dimensional architectural ideation. Physical models are valued as form-finding tools for space ideation as well as for training a haptic and visual conception of space. The use of the referred *configural containers* is favoured as a means of framing spatial ideation in order to achieve greater teaching effectiveness and creative enhancement, as it provides a certain support for the students' confidence however unfolding an unlimited range of exploratory alternatives. Despite the apparent constraints that such previous imposition entails it does not lead to a loss of creativity with regard to the students' spatial imagination that is conveniently nourished with an imaginary of references as much useful as they are necessary. The work of sculptors as much as that of architects is adequate at this learning stage to enrich the mentioned student's imaginary and help them to produce quality work.

1 Introduction

Traditionally, pedagogical strategies in relation to architectural ideation were basically confined to the field of graphic expression and *drawing*, being raised by Seguí (2000) at the School of Architecture in Madrid and later disseminated to other schools. Perhaps less attention has been paid to the possibility of experimenting in space with *physical models* directed towards volumetric and space configural exploration (Marcos 2008). In both cases, the difficulty of implementing approaches

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associated to ideation—perhaps the reason for a certain reluctance within our area of knowledge regarding the applicability of such pedagogical approach—lies in the fact that it should address a real process of ideation focused on spatial configuration but without having to make a real architectural design. These teaching practices also try to favour an active positioning of the student in this pedagogical process, therefore complementing other graphic activities based either on representation or analysis of existing referents—practices, on the other hand, also useful and necessary in architectural teaching.

Furthermore, the attempt of educational innovation in architectural ideation may be founded and substantiated—as has been evidenced in certain teaching experiences recently circulated at conferences and journals (Marcos and Domingo 2014, 2015)—in the use of direct architectural referents, in contrast to non-specific, or in the prevalence of the figurative and tangible against the abstract and indeterminate. However, it is also possible to work on it using physical models.

Thus, models of ideation with direct architectural referent can be considered within the status of *configuration models* as stated by Carazo (2011, 35), that is "scale models carried out as working tools, intended, in this case, for the author himself and produced during the process of materialization of the idea, exploring possibilities that will finally be embodied in the project". Being however impossible in our case, since no architectural design does really exist, we try to raise similar strategies to this ideal situation designing a pedagogy based on the use of *configural containers* and *spatial order systems*, so that it may trigger the students' creative process to attain a three-dimensional form. Consequently, also as a visual and haptic exploration of space (Pallasmaa 2006) (Fig. 1).

We conceive *configural containers* as volumes of varying complexity—without structural or structuring elements previously associated, taken as a reference for the physical model to be developed inside it or, eventually, to be transgressed, but always being visibly manifested wholly or partially in the final proposal. It is possible to work on it isolatedly or in combination with order systems or spatial organization systems (Ching 1982), always from the perspective of ideation, to formally and functionally interrelate the different configural spaces generated.

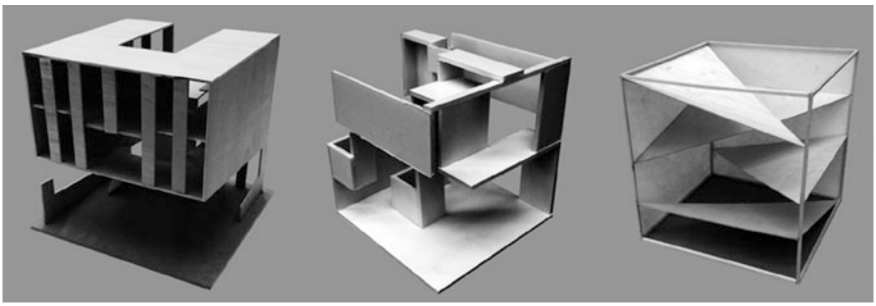

Fig. 1 Elementary configurations based on a cube. Students: Adrián Andrés, Emilia Mittmann and Anna Maly

2 Strategy

From the above, we have a tool and a method to work on that becomes an effective support during the process of "materialization of the configural idea," both for students and, eventually, for the architect himself.

At first glance, one might think that our approach, scheduled and supported in the mentioned *configural containers* may be considered counterproductive because of its limiting or "constraining" character within the ideation sphere. However, there are many who authoritatively argue otherwise with respect to this type of regulated processes, both in the world of creativity in general and in their particular fields. In a highly topical field such as advertising, Goldenberg recent studies not only credit them for their practical side, but have managed to experimentally prove their direct involvement in creative excellence (Goldenberg 2009, 33).

In his well-known *Musical Poetics*, Stravinsky wrote: "The creator's function is to sift the elements he receives from her [imagination], for human activity must impose limits upon itself. The more art is controlled, limited, worked over, the more it is free. As for myself, I experience a sort of terror when, at the moment of setting to work and finding myself before the infinitude of possibilities that present themselves, I have the feeling that everything is permissible to me. If everything is permissible to me, the best and the worst; if nothing offers me any resistance, then any effort is inconceivable, and I cannot use anything as a basis, and consequently every undertaking becomes futile." (Stravinsky 1947, 63).

The field of creativity is like a vast territory which we need to demarcate to be able to control, so that the self-imposed previous order of the author—in the words of Antonio Miranda—may validate the consistency of a certain design in accordance with the rules that the author imposes over the object of his production.

Furthermore, Eco emphasizes the need for "constraints" within any artistic content": A painter who decides to use oil instead of gouache, a canvas and not a wall; a composer who chooses a particular key; a poet who chooses to use couplets or heroic rather than alexandrine verses: all that constitutes a system of restrictions. It happens with avant-garde artists, who seem to elude restrictions; they simply set others that go unnoticed" (Eco 2011, 32).[1] Cubism, to mention a well-known example, tried to break with the rules of perspective pictorial representation fixed for centuries from the Renaissance onwards (Cooper 1984, 15). Therefore, it used representation systems that systematically questioned the idea of a single point of view and central projection derived from it even if it used different resources such as the multifocal fragmentation of the analytical period or the essentially flat representation in a compressed space evading depth characteristic of the synthetic period.

[1]T.N. The literal quotes, excepting Stravinsky's quote, have been translated from the Spanish version of the text as we have either been unable to access the published English version or there is no published English version of the texts.

In the field of painting we find illustrative experiences such as that of Purism at the beginning of the last century in which flat compositions are subjected to the "rigour" of the so called regulating lines (Fig. 2).

Many of the paintings produced by Le Corbusier between 1919 and 1930 (approximately half of them) used a format called 40F, 100 × 81 cm. Over most of them a similar scheme to the one in Fig. 2 could be traced to obtain "a proportion of the canvas together with some points and inner axis that are capable of accurately sustaining and ensuring the effectiveness of the most challenging spots within the composition" (Quetglas 2008, 68). Thus, the painting is freed from potential abuses that could lead to its imperfect or difficult appreciation. It must be noted that Le Corbusier did not confer regulation lines a specifically generative function or a contribution to creativity, although he neither denies such a possibility when he states that they do constitute "a geometric or arithmetic means by which to give the plastic composition (architectural, pictorial or sculptural) great precision in its proportioning [structuring]. There is neither mystic nor mystery, but a simple adjustment, a purification of the intentions that the artist applies to his work. The regulation lines do not provide lyricism to work… [but] as the composition is refined the intention is fortified" (Le Corbusier 1929, 13). The apparent absence of poetics does not imply, in our opinion, a lack of creativity. These geometrical attempts employed by Le Corbusier are but the transposition to painting of the idea of order so present in the architectural discourse since ancient times and so often employed by the Swiss himself in his *Vers une architecture*. On the canvas, this transposition, acquires a *status* of internal order ensuring a compositional structure in the establishment of a harmonious balance. Le Corbusier himself wrote in those years, "The highest pleasure of the human spirit is the perception of order" (cit. Sancho 2000, 73). Although it would be necessary to add that this order is rather classic when compared with the closest precedents of Synthetic Cubism and in particular to the previous work by Gris and Picasso. Modernity is freed from the

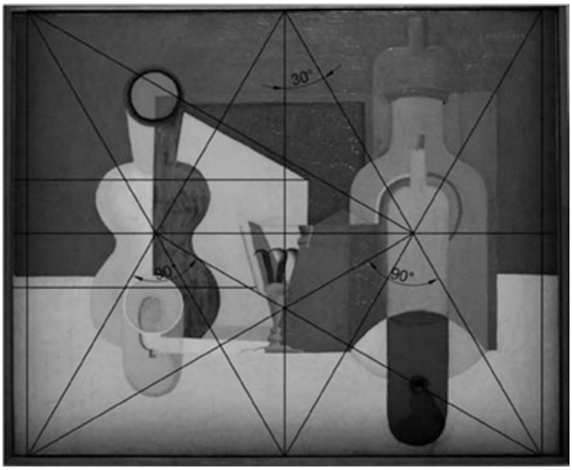

Fig. 2 Illustration based on no 52 by Quetglas (2008, 68). La bouteille de vin orange (1922)

rigidity of axial symmetry as an inherited artistic value of classicism, a compositional reliquary that Le Corbusier had great difficulties to evade in most of his purist paintings and his celebrated villas of the 20s despite their unquestioned modernity.

Quetglas (Ibid. 69) also notes that the horizontal projection of Villa Savoye is a rectangle of proportions adapted to the same regulatory scheme shown in Fig. 2. Our interest however lies on the imposition of a strict perimetral limit—both superficial and formal—for the development of the three floors in its interior space. The importance that Le Corbusier confers to the definition of the limit is evident in the sketch of the 1928 version (which will eventually lead to the final settlement of the “first draft”) if we analyse the way in which the traces have been produced. The precise fine lines, measured and traced with a ruler for the outer perimeter contrast with the thick, freehand, uninhibited lines sketched in the interior over the preset orthogonal grid (Fig. 3).

Just by considering the line weights and the accuracy of their tracing, preparatory and auxiliary previous drawings can be easily differentiated from the project’s “definitive” strokes. Sketching illustrates with precision—temporarily and formally —an *outside-in* ideation process, beginning from the perimeter to later hierarchically locate the curve, the ramp and the partitions over the aforementioned orthogonal grid dimensionally regulated from a pre-set module.

It is important to document and convey to students, the existence, along with others, of this kind of spatial configuration processes, from a pedagogical point of view. Being our purpose the elaboration of a physical model, it is convenient to place the question in the sphere of three-dimensional representation. To achieve this we show them the famous types of architectural compositions illustrated through his 20s villas (Fig. 4) in which Le Corbusier, with obvious intentionality, uses axonometric and dihedral representation simultaneously.

This particular teaching strategy, based on the use of previous exterior configurations or *configural containers* is perfectly integrated into any of the three types

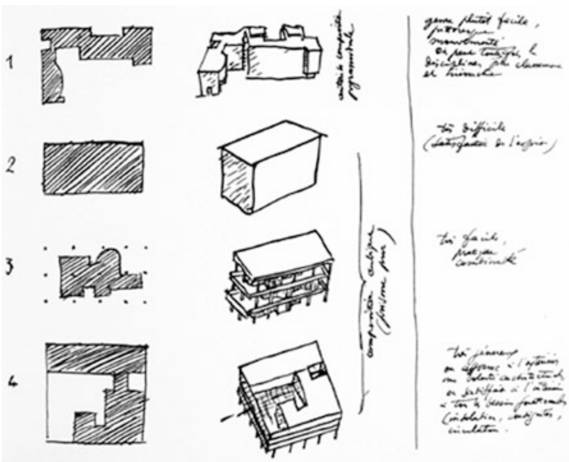

Fig. 3 Villa Savoye’s ground floor 1928 sketch

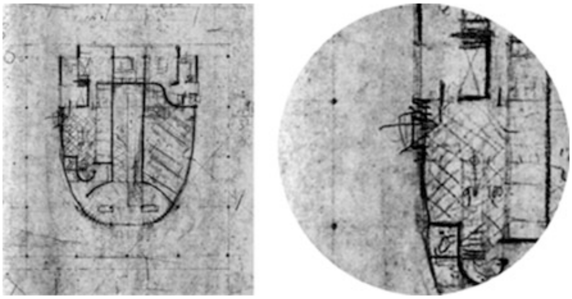

Fig. 4 Four types of architectural compositions, according to Le Corbusier

that Le Corbusier groups under the heading of "cubic composition (pure prism)" and, among these, we consider type 4 as the one with greater resemblance. It is easily identified with Villa Savoye with regard to which the master writes: "Very generous. An architectural will is stated [fixed] in the exterior. All functional needs (sun exposure, contiguities, circulations) are solved in the interior". We understand this as a more feasible option in students' works, as according to the definition originally put forward for the *configural container*—even if its whole manifestation is possible—only the partial use of the enveloping skin is fostered, distancing from type 2, as well as from type 3 because of the absence of the mentioned skin (which, nevertheless, does not imply total absence of physical configuration). In fact, our concept does not differ much from corbusean "pure envelope" pointed by Reichlin (1985, 40), since it deals with a problem of geometry considered as a structuring element, not to the degree of surface colonisation, although part of the work in which our students operate deals with the articulation of the outer skin or shell.

Connecting with the architectural pedagogical tradition, the exercise of the most basic *configural container*—the cube—could be related to the well known *nine square grid* exercise promoted in the academic sphere of American architecture schools in the late 50s (Eisenman 1999: 27) and proposed in the design studios as a domestic architecture problem. It could also be considered an inspiration for some of the houses designed by the *Five* that would eventually produce some exemplary sequels across the pond years later (*Turégano House*, Alberto Campo Baeza. Fig. 5). Exhausting the disciplinary history, it could also be related to the compositional schemes proposed by Durand, although in the teaching experiences referred here always trying to follow a haptic and constructivist three-dimensional approach of the architectural space.

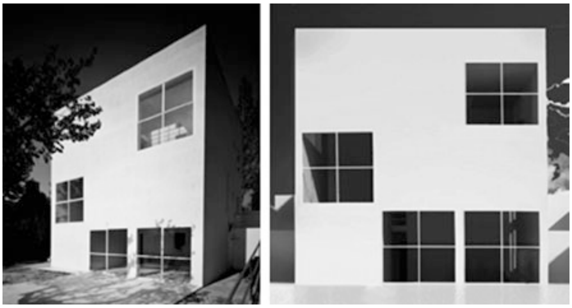

Fig. 5 Turégano House, Alberto Campo Baeza (1988)

3 Activity: Framework and Development

First, it is necessary to point out that three-dimensional physical models are consistently integrated in the practice scheduled throughout the course within the Graphic Analysis and Ideation 2 (AIG 2) subject, either as a validation of specific elaborated graphic ideation exercises (Marcos and Domingo 2014), either as autonomous teaching practices. Indeed, the training discourse is partially based, on the one hand, in the belief that the swiftness of freehand drawing, on any medium, whether conventional or computerised, is irreplaceable and, on the other hand, in considering that the correspondence between handcrafting and the mechanisms of graphic thinking can be intimately related in the design of the architectural object.

Regarding the elaboration of the models, this prospective drawing is used both, before and simultaneously during their construction; accordingly, it should be included in the final delivery of the work as an important phase of it (Fig. 6). Not only should the final result achieved by the students be assessed, the process itself may be as important as the result attained. All germinal and tentative explorations generate an internal history of the design to be validated and are also embodied in the various sketches made before or during the actual construction of the physical models.

The models derived from predetermined spatial configurators are not the only type of exercises dedicated to three-dimensional physical ideation. Other teaching practices employed for years (Marcos 2008) are possible and necessary to experience the most basic spatial concepts in the field of spatial configuration, that is, systems that could be referred to as space colonization strategies: *Subtraction, limitation and addition* (Fig. 6).

The results achieved here are more sculptural due to their more abstract nature and to the use of references of artists who have mastered these strategies regardless from architecture. For students this activity has however proved very useful as a first approach with materials and techniques that will later be used (Fig. 7).

This sculptural character must be understood as a learning process of a generative grammar of forms in space, improving the plastic training for the future architect. Their acceptance, though, requires a previous introduction on theoretical knowledge that will allow the student to undoubtedly discriminate what is essential and inherent to each discipline. Furthermore, for both, the sculptor and the architect

Fig. 6 Spatial colonisation by subtraction, limitation and addition. Students: María Córdoba, Paula Pastor, and unknown student

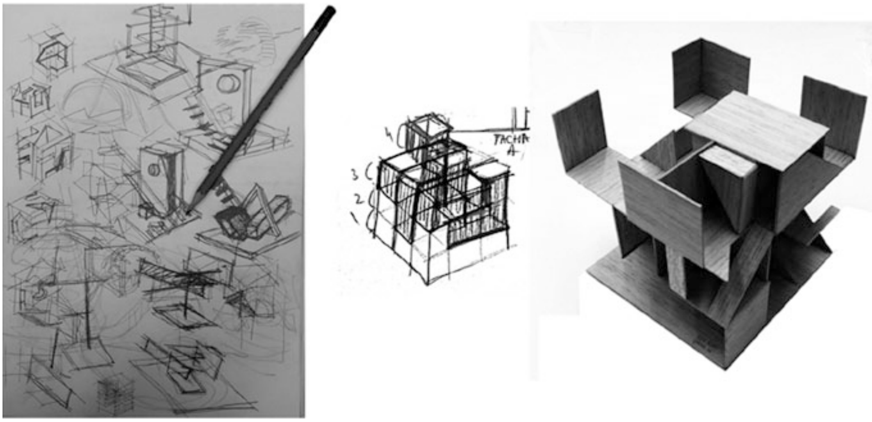

Fig. 7 Graphic and three-dimensional physical ideation. Student: Eliza Neagu

form is necessarily related to the colonization of space though, especially in the case of the latter, this colonization must also produce void volumes; in this sense, these strategies are common to both disciplines. Thus, the development of these models is always preceded by an overview of fully contextualized references of the work of different artists such as Chillida, Palazuelo, Oteiza, Tatlin, Malevitch, Vantongerloo, Rodchenko, Caro, Pevsner, etc. Exercises based on limitation could be directly connected in some cases, to Oteiza's *metaphysical boxes*. The intentional use of plastic or architectural references from various authors constitutes a primary source of images intended to enrich the students' imaginary, scarcely nourished in this field for most of them in their second year of career.

Obviously a *configural container* is a self-imposed geometry, not necessarily a goal in itself. Therefore, the container must not necessarily be a cube; any relatively simple geometry could serve as a trigger for space exploration; its importance laying on its enveloping of the geometry within whose boundaries the students must develop

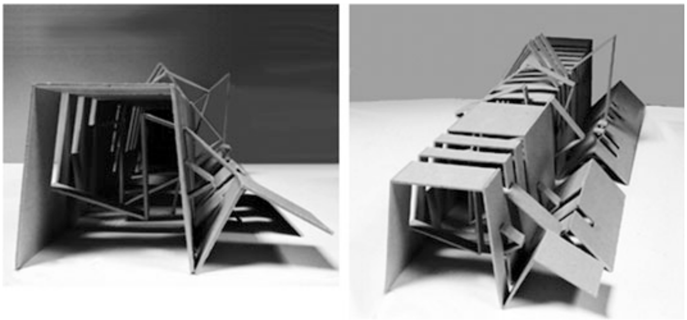

Fig. 8 Configuration based on a straight prism and a linear composition system. Student: Julia Ruhkamp

(a) (b)

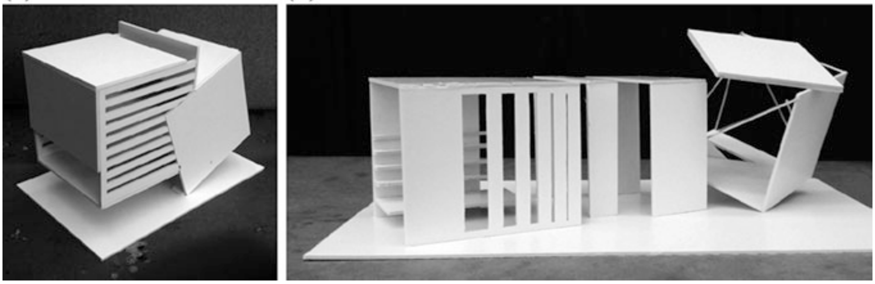

Fig. 9 **a**, **b** Configuration based on two cubes and on a parallelepiped and a cube. Students: Luis J. Torrecillas and Ana M.ª Alfaro

a formal investigation limited only by their own imagination. Figure 8 shows an exercise with an elemental container originated over a straight pseudo-prism.

Moreover, configural containers do not always have to be *elementary shapes* in the sense of simple single volumes, they can also comprise two or more easily identifiable elementary geometries as shown in Fig. 9a, b.

In these cases, especial care must be dedicated to the particularities of the different grouping situations developed so that students identify and ponder the advantages and disadvantages of each strategy to be eventually used in their future architectural designs. *Intersections* will require exploring the nature of the visually and physical shared space, carefully dissecting which noticeable and immaterial variables are to be affected. *Juxtaposition* will require a previous study of the contact alternatives and modes—punctual, linear or superficial—and their suitability in terms of relational objectives that arise. Finally, if elementary containers are to be separated, the concept of active proximity should be explained and assimilated through the study of shared variables (function, view, lighting, protection etc.) as well as the concept of *unity* of the whole design. In this case notions

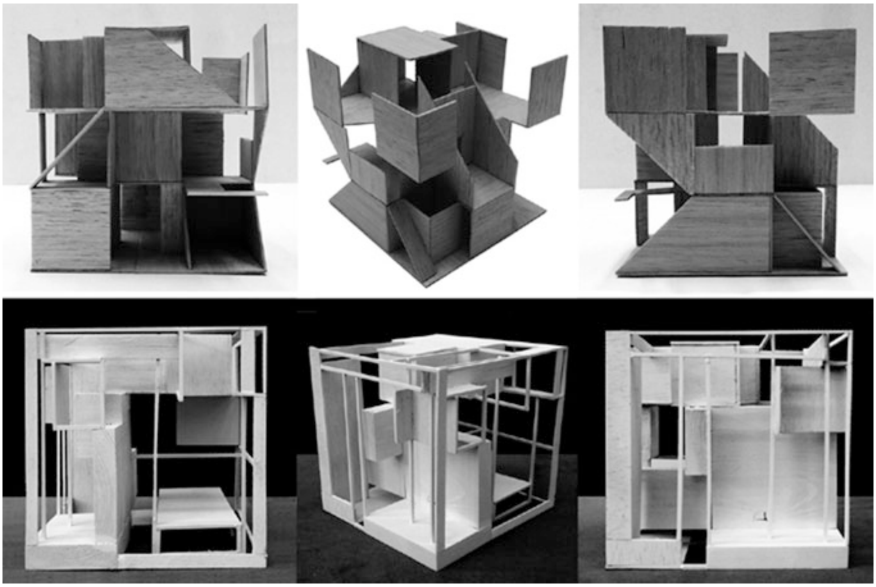

Fig. 10 Cubic configural container. Order systems: orthogonal grids with simple and complex rithms. Students: Eliza Neagu and María Felío

such as proximity, absence-presence, rhythm and all perceptual variables involved play a key role (Arnheim 2001).

Continuing an established architectural tradition, the use of the referred order systems or spatial organization systems is proposed to students in order to provide them with tools for a compositional organization of space (Marcos 2008). These are basic tools that have always been present in the configuration of architectural space throughout the centuries. As unambiguously has shown Ching (1982), most of these—linear, central, clustered, radial, and gridded organizations—have been used historically, regardless of culture and time. Even today they can be of great aid on the difficult task of plunging students into architectural ideation.

Order systems allow to delve into configurations that are based on the importance of the interior, in inside-out processes, to be used as tools for grouping any number of elements and their overall organisation in order to achieve a unitary design, either in a single geometry or in a complex system. While this type of practices are beyond the scope of this text and constitute an independent educational unit, it is nevertheless possible to combine order systems as a tool for the configuration of interior spatial possibilities in elementary configural containers, individually or in groups (Figs. 10 and 11). Their application is also useful in the articulation of the enveloping surfaces (Fig. 11). Neither do these systems prefigure an enveloping surface that necessarily constraints the spatial configuration possibilities; they only ensure a consistent relationship that allows to articulate forms in space according to a preset order.

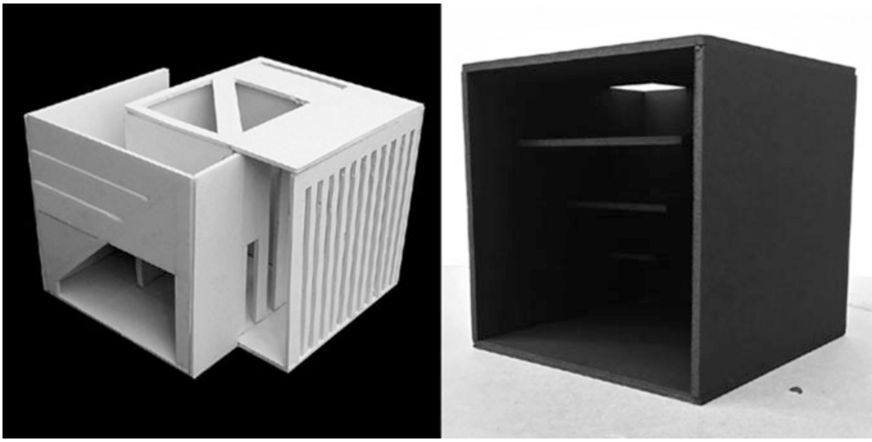

Fig. 11 Static and dynamic space. Significations through zenithal and side-rhythmed lights. Students: Borja Vilaplana and Anna Maly

The initial Fig. 1 shows how ideation practices with *configural containers* may support different levels of formal approximation to real architecture (decreasing in the figure to the right), depending on the eventual pedagogical objectives addressed. In any case, this type of exercise can always address essential concepts such as order, articulation, absence-presence, interior and exterior space, static and dynamic space, rhythm, light, composition, etc. (Fig. 11). This training may significantly contribute to prepare students for architectural design courses in which other layers of complexity must be superimposed on the justification of the form such as may be the programme, the construction, the structure, or the context, just to name a few. Thus, in our opinion, the propaedeutic mission in these exercises is evidenced in as much as students acquire tools to tackle architectural designs with increased confidence or are able to understand through experimentation influential plastic references concerning modern architecture to be addressed in courses of Architectural Theory or History of Architecture.

4 Conclusions

Space ideation practices employing configural containers are not a goal in themselves beyond the students' initiation in space configuring. These practices are raised with the propaedeutic intention to nourish students with a rich plastic imaginary and to contribute to increase their design capabilities through these strategies basically oriented to architectural design but also, to a lesser degree, to Architectural Theory or History of Architecture.

The *initial position* of the course within the plan of studies of the Degree in Fundamentals of Architecture involves dealing with still very elementary concepts, although absolutely essential, as are the notions of order or composition, on the one hand, and the categorization of space or its corresponding signification by means of variables such as light and colour, studied previously—generically and non-specifically—during the first year in Graphic Analysis and Ideation 1.

From a pedagogical point of view, they are specially credited as an application of the so-called *constraints* in the processes of ideation, a factor of creative enhancement thanks to the contribution of an effective frame or support for design confidence in the neophyte.

They are also credited for direct haptic and visual experimentation, that make of them a powerful and necessary instrument of *spatial apprehension* after having taken the course of Descriptive Geometry.

In relation with the preceding paragraph, they are also conferred a fundamental value in understanding the relational phenomena between different individual spatial entities (intersection, articulation, juxtaposition, proximity, etc.), allowing their subsequent grouping.

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Technology Transfer: From the Film Industry to Architecture

Federico Luis del Blanco García and Ismael García Ríos

Abstract The purpose of this writing is to analyze different visualization techniques used in the film industry, so they can be used in the field of Architectural Graphic Expression. Over the years the film industry has developed techniques, specific hardware has been manufactured and new applications have been designed. They have subsequently been adapted so they could be used for architectural visualization. The film industry is constantly evolving and always stays one step ahead. "Time" factor is added as a new important parameter to consider. If you have the knowledge, one could make animations that simulate three-dimensional environments from static images without expensive resources.

Keywords Techniques used in the film industry · Architectural visualization · Transfer of technology (TOT)

1 Structure

The structure that we have used in order to analyze the different techniques in this paper is subdivided in three different points, attending to its dimensionality (Fig. 1):

A. Two dimensional environment techniques:

- Still-images sequences that allow us to make never ending zooms.
- Animation of images inside a two-dimensional environment, emulating a three dimensional environment.

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Fig. 1 "Matte Paint" used in the film Star Wars

B. 2,5 dimensional environment techniques:

- Projection of still-images on two-dimensional surfaces, emulating a three-dimensional environment.
- Use of 2D surfaces inside a 3D environment, emulating real 3D environments.

C. Three dimensional environment techniques:

- Projection of still-images on three dimensional surfaces.

At the end of the paper, we analyze how to compose architectonic elements generated using conventional techniques—either in two or three dimensions—inside virtual environments ("3D camera track" y "match moving").

Due to the graphic nature of this paper, we have added links to a series of videos that have been done by the authors of this work, and a selection of animations done by different artists specialized in this field of expertise. https://www.youtube.com/watch?v=fE17WDunkEs&feature=youtu.be.

2 Content

"Matte painting" techniques are even older than the video cameras. Film industry had already developed their own techniques to introduce actors in a nonexistent environment before 3D modeling software, animations or photomontages techniques were developed. Before the digital era, the artists painted large canvases that served as background scenes. Thus the realization of real scenarios were avoided and made it possible to make scenes that would otherwise have been impossible.

Ben Hur is an example of the first generation of films in which these techniques began to be used. They could recreate the classical world of Rome using paintings. The progressive development of different techniques have allowed the reconstitution of fantastic or futuristic cities. The architectural design has increasingly gained importance in film industry.

The use of computers and the development of specific software and hardware have led to a transfer of traditional painting techniques to computer tools. Watercolors and large paintings have been replaced by graphic tablets and pressure sensitive pencils, working on programs like Photoshop (still image), After Effects, Nuke (animated image), 3DMax, Maya or Cinema4D (3D modeling).

3D models can provide extremely high detail and more accuracy than handmade models. However, 3D modeling needs time and expensive resources in order to render a scene.

The methods that we are going to analyze can efficiently combine 3D modeling techniques with the elaboration of pictures or collages: we can use a projection system using computer applications, reducing the processing time of scenes and minimizing production costs.

This system makes it possible to elaborate animations and architectural renderings not only for movies. Anyone, with the necessary knowledge and skills, can use them in other areas of expertise. The transfer of advanced film techniques to the Architectural Graphic Expression provides high quality standards in the representation of architecture. The limited use of these techniques in the field of architecture is mainly due to both, its almost no teaching in architecture studies and the lack of specialists in this field.

The study of these techniques has been structured according to their dimensionality in order to have a better comprehension. Each technique may require different software although all of them are within the same field of specialization.

3 Two dimensional environment techniques

– *Still-images sequences that allow us to make infinite zooms.*

We can use this technique to make successive zooms using still-images instead of videos. Using photographs, ortho aerial photos or handmade drawings decrease production costs, reduces the processing time and allows the artists to have full control over the graphic result.

The main problem we can encounter using this technique, is the limitation of the resolution of the image. If we make a zoom, the image will appear pixelated. To solve this problem, we need to use multiple images at different scales focusing on the same point, framing one inside another. Thus, using the zoom we can move from one image to another solving the resolution problem. We can use as many images as we want, with the possibility to make a never-ending zoom.

The video “Powers of ten” by Ray and Charles Eames was done this way but manually. It starts with an everyday scene and then the point of view goes away progressively towards the universe. The order is reversed on the second part of the video. The impossibility of having a single image with hundreds of millions of pixels to make zoom on, forced the Eames to use a sequence of images that are focused on the same point (Fig. 2).

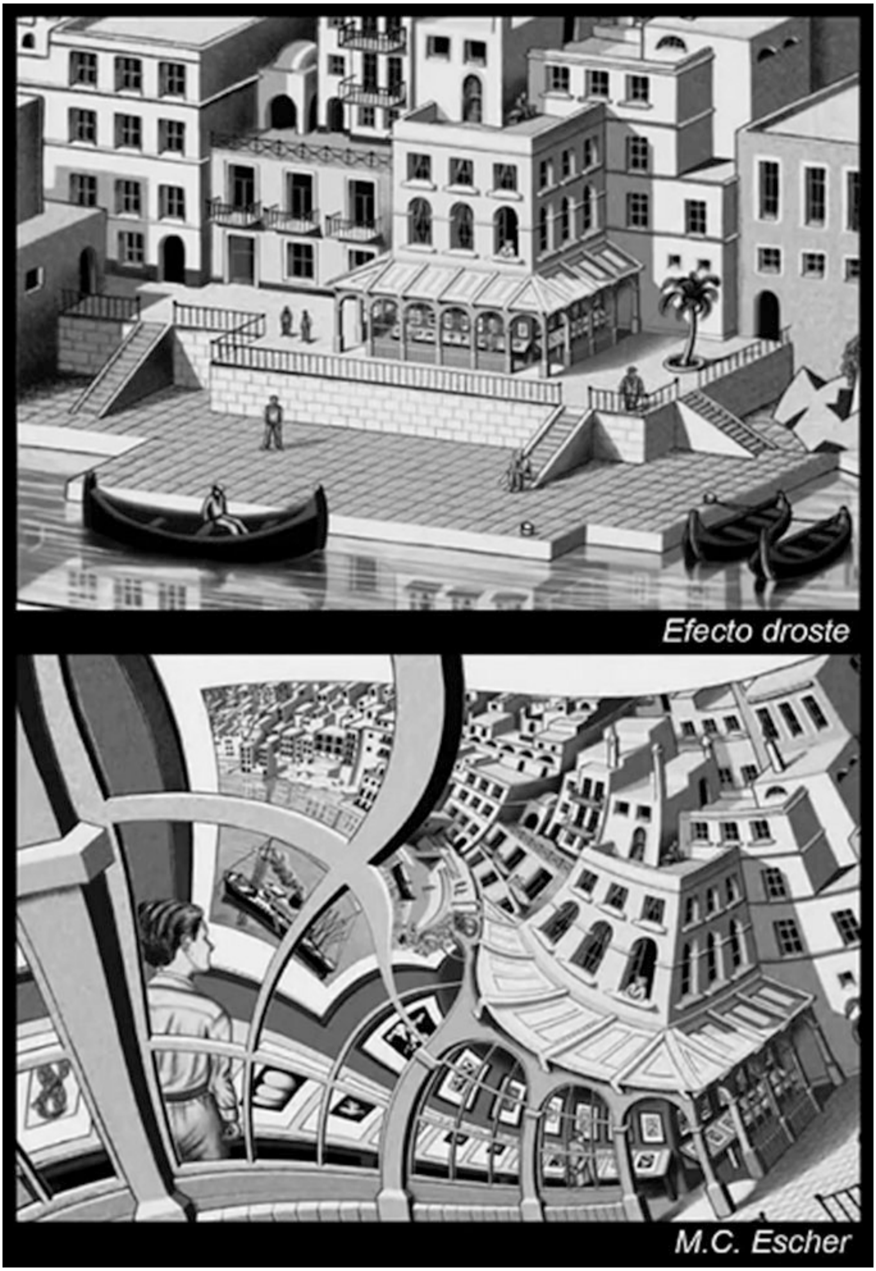

Fig. 2 Animation of M.C. Escher lithograph, making an infinite loop

Applications such After Effects allow us to make these kinds of animations with quality and precision. We can find the mentioned example in the following link: https://www.youtube.com/watch?v=fbCwkfrKuaw (*Potencias de diez—Powers of ten*).

Another interesting example is found in this animation presented in the "Canal de Isabel II in Madrid for the exhibition of the work of M.C. Escher". It explains this amazing composition of the great artist. A painting in a room shows a building in which we find again the same painting. It generates an infinite loop where we are able to see the same lithograph again and again. https://www.youtube.com/watch?v=9WHdyG9mJaI (*efecto droste de M.C. Escher*).

In order to animate an aerial image that comes closer to our project, we can sequence different images that contain the project on different scales.

– *Animation of images inside a two-dimensional environment, emulating a three dimensional environment.*

It is possible to animate images to make a video as if it were a collage, using trimmed images.

This is the most straightforward technique for inexperienced users because of its immediate results. We can change the scale of objects and the vanishing point to compose the scene as we do in a perspective drawing.

This technique isn't very effective if we have to make several projects. Because of its almost hand-made nature, we have to start every new project from the very beginning.

Designing 3D models is more effective if we are planning to render many images, because we can reuse the work on different scenes. If we change the point of view in a 2D environment design, there is almost no reusable material.

To make a project, we could use still-images as well as animated videos. Anything that is animated will reproduce the same way in the composition. Every animated object is played throughout time.

Because of its manual nature, the variety of solutions of this technique is unlimited. We could make photo-realistic compositions, conceptual animations or a combination of both; the only limitation is the skill of the artist (Fig. 3).

In the following link we can find an animation of this type explained step by step: https://www.youtube.com/watch?v=1UaEUznz2zM (*Tom Hisbergue*).

4 2,5 Dimensional Environment Techniques

– *Projection of still-images on two dimensional surfaces, emulating a 3 dimensional environment.*

This technique is very efficient because it allows us to visualize and animate a 3D environment using 2D surfaces on which we project images. It is the technique most widely used on movies because it generates a 3D virtual environment with few resources and little time (Fig. 4).

Fig. 3 Animation of a scene using trimmed images inside a 2D environment. Tom Hisbergue

This method of projecting images simulates a flashlight. We can project images on planes at different depths in the same way as we do with a physical projector on a wall. If we place the line of sight coincident with a particular perpendicular line to the planes that will be the path of the animation, we will not appreciate that the images have no thickness. If we move forward or backward along that particular line, a false 3D space that the viewer perceives as authentic will be generated.

An advantage over 2D techniques is that the software itself generates the fictitious 3D environment, performing calculations and finding exactly the different points of view that generate the animation. We need to determine the depths at which we place the different projections planes. This enables us to distort at some extent the perception of the space we are designing.

The limitation of this technique is shown when the point of view is not in the straight line path of the animation. The more the point of view get away of this line the more the image is distorted. An excess of deviation cause the viewer noticing that the planes are two-dimensional. You can move the point of view of the camera out of the line within acceptable margins. Thus, an expert viewer who knows the techniques may recognize these sets.

A more complex variation of this technique is to use the mentioned above system of projections on planes that are not perpendicular to the view. We will explain it later with the 3D techniques, because the method is the same that we use when we project images on volumes.

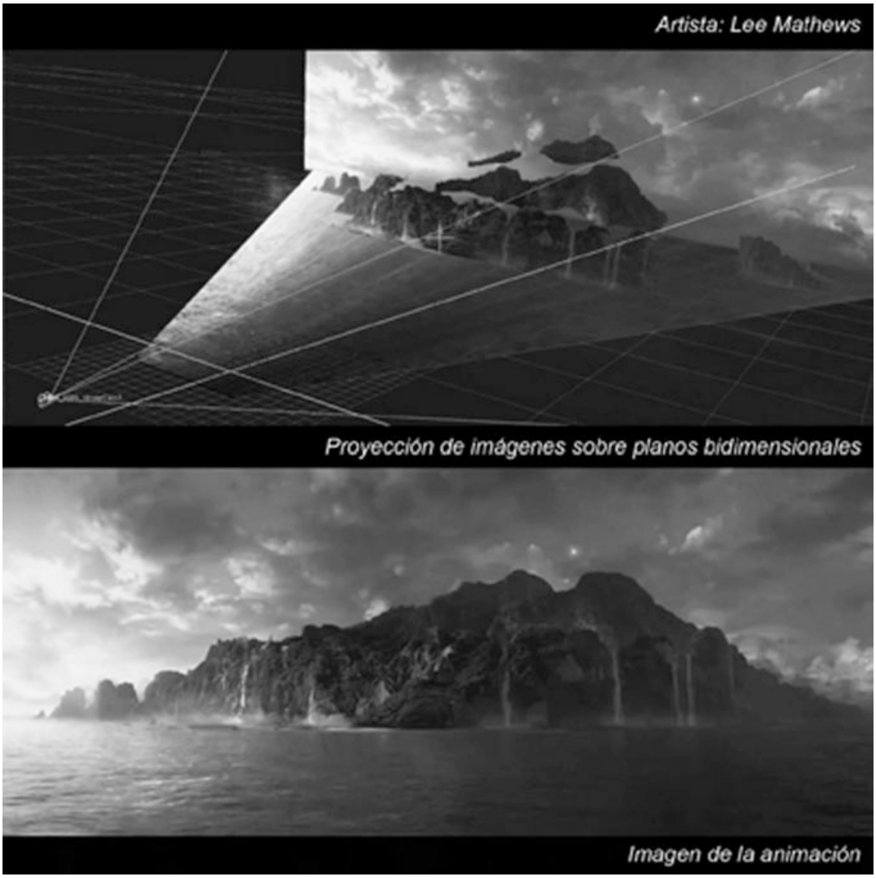

Fig. 4 Projection of several images on 2D surfaces placed in different depth. Lee Mathews

The most important factor of this technique is the quality of the image to be projected. Because of this, there are artists specialized in this type of illustrations. Using images in the final design allows great flexibility and graphical variety. Any 2D drawing can take part in a fictitious 3D space.

This technique provides excellent results much easier than 3D modeling and also requires fewer resources because the computer will render each frame almost instantly. No calculating lighting and shadows are needed, because they are in the projected image. Despite the advantages it is a technique little known in the field of architectural graphic expression.

– *Use of 2D surfaces inside a 3D environment, emulating real 3D environments.*

This technique is a variation of the above. We can get a similar result if we use planes that contain the image, trimmed by an alpha channel.

In practice, both techniques are combined. The projection technique is more flexible and allows us to project on planes that are not perpendicular to the view. However, if we use planes mapped with images we do not need to project.

The puppet theaters use this planes configuration. They are a succession of planes with images one after another at different depths without using volumes. As the line of sight is perpendicular to the planes, the lack of volume is not perceived. The scenery would not work if viewers could see the space laterally.

Three-dimensional environment techniques:

– *Projection of still-images on three dimensional surfaces.*

This technique is similar to the projection of images on planes, but in this case we project on 3D meshes (Fig. 5).

Fig. 5 Projection of images on three-dimensional meshes

The composition of the scenes are more flexible using this technique, because projecting on volumes reduces the restraint of the camera. Since the image is projected on a mesh with a similar shape to the original object, if the observer moves away from the straight path projection (perpendicular to the planes), the projection will suffer much less distortion.

However, the time required to generate these scenes is much higher, since we need to model 3D objects and place them into the scene.

A complex 3D model can be simplified using these projections. Thus, the modeling of natural scenes is simplified considerably. We just need to make a volume similar to the desired result, and project on it an image with all the details, colors and lighting (Fig. 6).

Fig. 6 Projection of an image on three-dimensional volumes

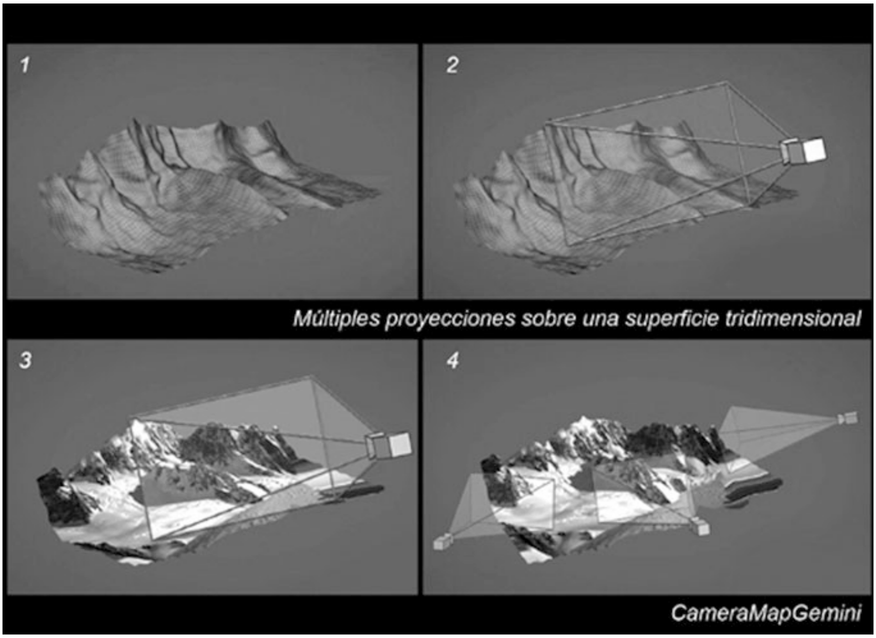

Fig. 7 Multiple cameras projecting on a three dimensional mesh. Project Camera Map Gemini

To carry out this technique, we need a software like 3D Studio, Maya or Cinema4D. These programs allow you to model in 3D as well as having a system based on cameras that emulates projectors. A second camera will be used to record the scene. There are specific "plugins" that add functionality to the programs described above, such as CameraMapGemini, currently in beta version (Figs. 7 and 8).

This technique allows an animation of an existing canvas. We can model 3D objects that correspond to the drawing, and then project the image on them to make the animation: https://www.youtube.com/watch?v=PuoqmsYSnyA (*animación realizada por Michel Valentin*).

In the following link we can see the process shown by Dimitris Katsafouros to make his animation, "Something out of nothing", based on the London Bridge. After a basic 3D modeling of volumes, the author adds details using this technique with projections: https://www.youtube.com/watch?v=cNhII-Gh2_M (*animación de "Something out of nothing"*).

We can find a variation of this technique in the "video mapping". Instead of projecting in a program as a 3D simulation, real projectors can be used to project images on buildings or other items. https://www.youtube.com/watch?v=jDHfa03XzaM (*3D vídeo mapping projection*) (Fig. 9).

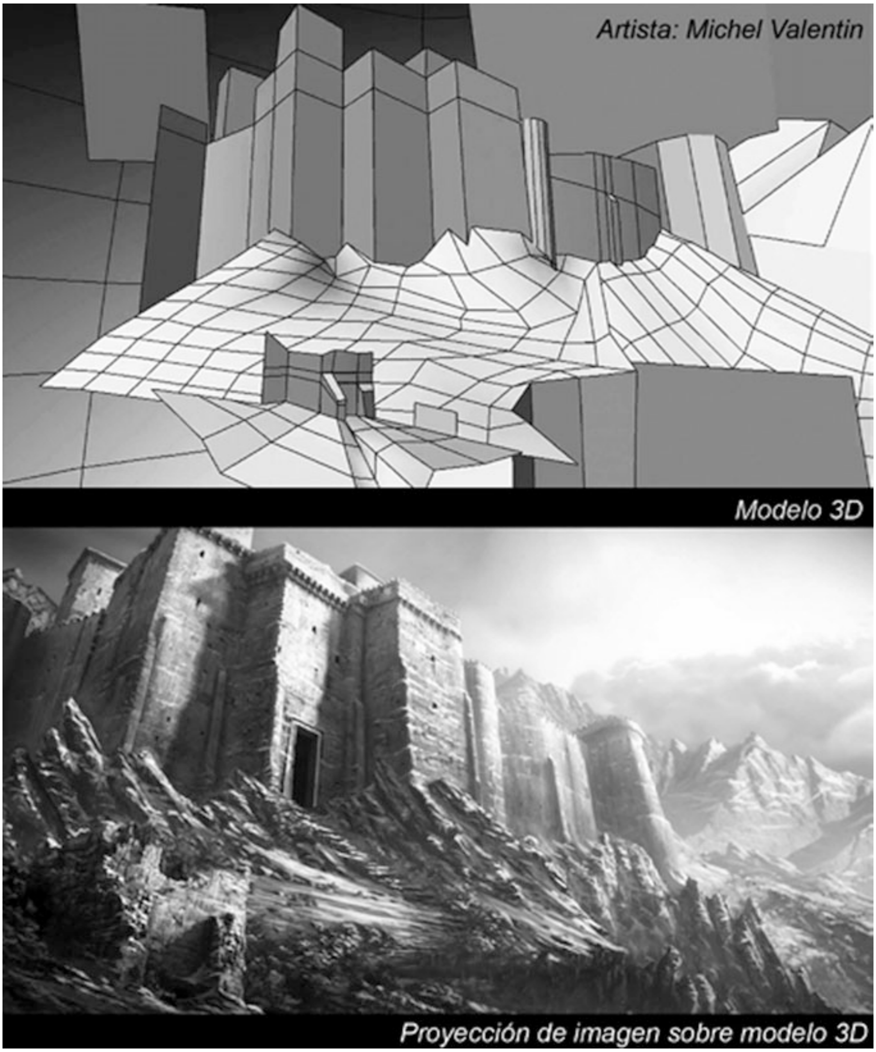

Fig. 8 3D model from a picture, the canvas is projected on the 3D model. Michel Valentin

– *"3D camera track" and "match moving".*

The latest techniques to analyze is excluded from the general structure that we described, which was dependent on the dimensionality indicated at the beginning of writing. This is because we work in a 2D space, and the software will recognize the depth and scale of objects, adjusting the size, orientation and visual corrections to the vanishing points of the scene.

"3D camera track" is the technique that generates a virtual camera from a video. The camera will have the parameters used in the recorded video. That will allow us

Fig. 9 Aadding 2D and 3D objects in a match moving sequence

to use it in a 3D virtual environment, or in applications such After Effects or Nuke that work in 2D but are able to simulate the third dimension.

If we use the camera generated with the above applications, the software will automatically recognize the objects in the video almost as if they were three-dimensional. The great advantage of this technique is that when you insert any object in the video, its size, scale and vanishing points will be automatically adjusted by the program, avoiding errors ("match moving").

Fig. 10 Grey scale image that allows the software to detect different levels of depth

Thus, this technique has advantages in both 2D and 3D. However, this method can generate its own complications. Making cuts in previously animated videos needs a major effort and time consumption. That is the reason why recording people for films is done using neutral colors (blue and green usually).

The following link explains the technique described step by step, as well as other aspects that we have not studied in this article because of the space limitations. https://www.youtube.com/watch?v=fE17WDunkEs&feature=youtu.be.

There are other techniques that enable the recognition of the third dimension (depth of the scene) in 2D animations with the help of grayscale channels. This is especially useful when we are using 3D modeling software, because they can generate these channels automatically (Fig. 10).

We can convert flat images into volumes using displacement maps. This is especially useful if the line of sight is very different from the one perpendicular to the plane of the image. As is the case of depth maps, such images can be automatically generated by the software if we are working in 3D environments, or manually generated if the scenes are two-dimensional.

The knowledge and use of these techniques open new paths and possible lines of research, extremely helpful for the architectural graphic expression. The analyzed techniques provide endless possibilities for the graphical representation of architecture, restoration of spaces and landscapes, as well as the animation of these scenes.

These techniques are fully implemented in the film industry, and they can be transferred to other disciplines, including architectural graphic representation and teaching.

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Author Biographies

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From Abstraction to Design

Rodolfo Mejías Cubero

Abstract While abstract thinking was born through language, it is through art that it has influenced other areas. However, its potential, as a resource and a creative force, is undervalued today. This essay intends to delve into the origins of self-expression through abstract art by taking a look at the thought processes involved, by seeking to clarify how they occur, and by exploring the possible relationship between this tool and other areas of contemporary architectural design. As a starting point, the assumption is made that abstract art contributes to the development of skills and to the management of tools in artistic disciplines, and it helps to incorporate concepts and principles of order into architectural projects.

Keywords Art · Abstraction · Architectural design

1 Introduction

Thousands of years before the advent of writing, the first forms of verbal communication arose, bringing about the origin of building knowledge and of language itself. Eventually, this would lead to writing and representation, including the establishment of relationships with abstract thinking, which in turn would lead to the development of signs, symbols, and images .

Since Wassily Kandinsky painted his first abstract work in 1910, this trend has evolved in different ways in different periods, ranging from geometric abstraction to abstract expressionism, among others. While abstract thinking came about with the dawn of language, it is through art that it has had an influence on other areas. However, its potential, as a resource and as a creative force, is undervalued today. The intention of this essay is to delve into the origins of the thought processes and the self-expression that is particular to abstract art, seeking to clarify how these

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mental processes occur and exploring their relationship as a conceptualization tool for architecture. It is based on the assumption that abstract art provides learning options which contribute to the development of skills, to the appropriate management of tools in artistic disciplines, thus contributing to the incorporation of concepts and principles which can be applied specifically to architectural projects.

As a scientific contribution, it is intended that by understanding the principles of abstract composition, the designer will have more available resources. Abstract painting is based on a triad consisting of the idea, the creator, and the viewer. Both the creative ability of the artist and the way the essence of ideas is interpreted by the viewer are more valuable than the figuration itself. The objective is to demonstrate that spontaneous and thoughtful expression of points, lines, planes, volumes, colors, textures, and strong lines in compositions can help form a more critical awareness about the origin of art and contemporary design.

2 Background

The functions of imagery: representation, symbol and sign.

Some authors place Jericho as the oldest city in the world (between 7000 and 10,000 years old); However, it is known that urban culture as such was born in Mesopotamia (modern Iraq); There, the Sumerians would give rise to the first known cities (Eridu, Ur, Kish, among others). It is no coincidence that the earliest forms of writing are associated with the birth of the first urban cultures.

> "The first form of writing takes the name" mythographic "(4000/3000 BC: Sumerians and Egyptians). At this stage, man learns to remember through semiographic recording. But mythographic writing is not sufficient for recording more general meanings, and, therefore, pictographic signs are combined in series in order to establish concepts." (Zapelli 2003, 23).

The hieroglyphic ideographic system (representation of ideas) is "ideogrammatic". That is, each of the drawings corresponds to an idea. On the other hand, in the "acro-phonic" systems (representation of syllabic sounds) the sign represents the word. Based on these concepts, Zapelli (2003, 26) states that, for example, in Chinese writing, every notion was represented by a conventional character, which at first was a stylized drawing. Greek culture (800 BC) creates phonemes from the graphic signs (graphemes), creating an alphabetic system that, since then, is used in the Western Hemisphere, according to the author.

However, as suggested by the German psychologist and philosopher, Arnheim (1986, 149): "*The simple line drawings can give visible form to the configurations of forces and other structural features.*" That is, is it possible that a simple graphic form can contain within itself the symbolic power of abstraction? Along this line of thinking, Arnheim (1986) states that representation as well as symbol and sign do not refer to three different kinds of images, and that they are actually the three functions of the image, which by themselves do not indicate their function. With the example of the triangle, the author states that it can be as much a danger sign, as a representation of a mountain or a symbol of hierarchy. However, when an image only serves as sign, it is largely because it denotes a particular content only, without reflecting its features in a visual manner. "*In the strictest sense, it is perhaps impossible for a visual object to be anything other than a sign… Inasmuch as images are signs, they may serve only as indirect means because they operate as mere references to the things they denote*" (Arnheim 1986, 150).

"*The images are representations to the extent that they portray things at a level of abstraction lower than themselves. They perform their function by capturing and demonstrating any relevant quality –shape, color, movement– of the objects or activities being described. The representations cannot be mere replicas, that is, true copies that differ from the model in random imperfections*" (Arnheim 1986, 151). This same author gives as an example of representation, the way a child represents a tree, using only a few circles, ovals or straight lines, all of which are highly abstract.

Finally, Arnheim (1986) states that an image acts as a symbol, as it portrays things to a higher level of abstraction than the symbol itself. "*A symbol gives a particular form to different types of things or constellations of forces. Every image is, of course, a particular thing and, referring to a certain type of thing, serves as a symbol, as in the example of presenting a dog in order to show what the concept of the dog consists of. In principle, any specimen or replica of a specimen can serve as a symbol if someone decides to use it for that purpose. But in such cases, the image leaves the effort of carrying out the abstraction up to the user*" (Arnheim 1986, 152).

3 Abstract Thinking

Is it the development of mental abilities which allowed the development of human intelligence and the evolution of man's intellectual ability to reason? Jaramillo (2004, 170) cites that some animals have intelligent behaviors similar to those of human beings, demonstrating an understanding of cause and effect, and the ability to solve the problems they are faced with, among other things. However, the reasoning ability of the human brain acts as an inhibitor when the individual is exposed to emotional states involving survival, but this is not always the case. Using the senses as a filter, the brain analyzes information and converts it into answers, some of these being immediate and others accumulating by way of memory. This is defined as "*the capacity to store or save immediate or delayed memories*" (Jaramillo 2004, 178). This author cites that almost all animals, from man to the simplest animal, have a memory. Moreover, intelligence has been described by scientists as "*the ability that people have to understand and learn, or to think abstractly*" (Jaramillo 2004, 170).

The conscience is the instrument that truly dominates all the phenomena perceived by the brain. Franco Fonatti (1988) points out: "*Conscience is not equivalent to consciousness or reason. Intelligence is the instrument of reason. The conscience is the sum of human understanding. Intelligence, in the strictest sense, is the ability to create mental images (pictures) based on perceptions received through the senses and the ability to convert these images, through an abstraction, into the ideas that are to be associated when the time comes to make a judgment or draw a conclusion*" (14).

According to authors such as Davalos and Raffta (2009), geometric skills, imagination, and three-dimensional vision are developed, for the most part, in the early stages of life. "*This is why one must look back to when one was a child in order to account for how drawing and geometry have been implemented and how they have evolved over the years; including the various tools used at each stage*" (63).

4 Reality, the Real and the Abstract

How real is reality, that which we perceive?

> In previous periods, it was debated whether visual images seemed real because they truly resembled what was real or because they successfully represented reality (Mirzoeff 2003, 65).

The time and the place define the convention used to define whether or not an image is "scientifically" plausible. "The images are not defined by a certain magical affinity to the real, but for their ability to create what Roland Barthes called the *reality effect*". "*The images use certain modes of representation which convince us that they are credible enough to end our distrust*" (Mirzoeff 2003, 65). Barthes' proposal, as exposed by Mirzoeff, does not mean that reality does not exist or that it is an illusion but rather it proposes that the main function of visual culture is "*to try and make sense of the infinite variety of external reality by selecting, interpreting, and representing it.*" For Arnheim (2002, 147), today we are far from the short-sighted belief that only a mechanically faithful replica is true to nature. Today, we realize that the whole range of vastly different styles of representation is acceptable. Real illusions, according to this author, "are rare because, in a given cultural context, the usual style of pictorial representation is not perceived as such because the image is simply assumed to be a faithful representation of the object itself. In this regard, Pablo Picasso declared in 1966: "I always look for the resemblance"; *and he exclaimed that the artist must observe nature yet never confuse it with the painting: "It can only be translated into a painting by using symbols"* (Arnheim 2002, 148).

He further claims that, in a well done work of art, the subject is perceived more so than is the form, which does not mean that the form is unimportant. "*This also holds for art that is "abstract" or non-mimetic. He considered there to be a huge* *separation between the fact that in an abstract painting, we see a provision of mere forms, visual objects that can be completely described by their area, shape, color, location,* etc.*, and the fact that, in contrast to this, we see the organized action of a number of visual expressive forces. In the latter case, the forms are eclipsed by this dynamic effect, which ends up being what conveys the meaning of the work*" (Arnheim 2002, 149). In this way, the form is not determined only by the physical properties of the material being used, but also by the style that is representative of a culture or of the artist who produces the work. This is where context comes in, not only with respect to the person who produces the artwork, but also to the public who receives it. The psychological reason why it is commonly acceptable for a visual object on paper to be very different from how it is seen in nature is that, first of all, in human perception and thought, resemblance is not based on a specific identity but on the correspondence of essential structural features, and, secondly, that an untainted mind spontaneously understands any given object according to the laws of its context (152).

5 What Does It Mean to Abstract?

Language as we know it is linked to the formation of concepts and to the structure of our system of ordered verbal communication through the meaning we designate to graphic signs. Graphic signs allow us to recognize concepts, but above all, to store them. Thus, we abstract through the symbolism that is present in the "graphics" of other disciplines such as mathematics, computer science, or art. "*Abstracting is a mental operation which consists of separating something from a specific content; that is, isolating one characteristic from the whole. Aristotle considers that separating the form or the essence from the material permits the formation of concepts*" (Davalos and Raffta 2009, 67). These authors claim that in psychology, this process takes place in two simultaneous phases; the positive phase in which the isolation of the characteristic properties of an object, such as color, takes place. And the negative phase, where the qualities of the object are put in second place, these being the size, the shape, and, especially in relation to drawing, the point, the line, and the plane.

> If thought takes place in the realm of images, many of these images have to be highly abstract since the mind often operates at high levels of abstraction. But reaching these images is not easy (Arnheim 1986, 127). As a first step toward understanding these highly abstract styles, we notice that "in certain natural conditions, a more realistic art would not serve the artist's purpose, but rather hinder it" (Arnheim 2002, 156).

In the Rupestrian images, what was being represented were the authors' manifestations of abstraction of reality; these were the reflections of the intellectual capacity of these individuals, schematically expressed through representations, symbols and signs.

In summary, abstracting consists in reducing the details of an item to a minimum and interpreting it without it losing its essence.

The architectural image through interpretation of the abstract image?

> The constituent parts of visual culture are not, therefore, defined by the medium but by the interaction between the viewer and what he looks at or sees (Mirzoeff 2003, 34).

Architecture uses the rest of the arts as tools. The ultimate goal of architecture is not the means of representation but the construction itself, and as such, the concept of projecting a space arises from an abstract concept. When drawing, the architects, as quoted by the architect Ana Torres Barchino (2010, 176): "*(…) we are gathering information and acquiring skills and expressive infinite graphic possibilities; in short, we become visually literate.*" Upon projecting, the architect appropriates the concepts of pictorial and tridimensional arts in order to: "obtain a specific graphic vocabulary; these are the basic visual elements such as point, line, contour, direction, tone, texture, size, scale, and movement, which will help us understand and analyze the overall structure of this language (Torres 2010, 177). As we saw earlier, only when thought is expressed is there expression, and, in the case of the architect, it is through multiple graphic records, as this author points out, that endless creative suggestions are born. As such, for the architect, images are not just a means of communication, but they are also resources for developing creativity. Through images, the architect "*designs*" new images. "*Communication through images involves a special magic (…) Does communication through images have the advantages of communication through words?*" (Aicher and Krampen 1991, 24).

Can the architect create his own production of abstract images to project? Can he use an abstract painting as a planning resource if he uses it as a metaimage? The main use of metaimages is to explain what the images are; to present the "self" of the images. "*We might wish to say that the self-is' just a metaphor' when it comes to images which are, after all, only lines, shapes and colors on a flat surface. But we know that images have always been more than that; they have also been idols, fetishes, magic mirrors: objects that not only appear to be present, but also have their own "life"; they talk to us and return our gaze. This is why using metaimages as tools for understanding images seems to question the knowledge of the observer*" (Mitchell 2009, 57).

Other methods of image interpretation, as provided by Panofsky, reside in the classification of three levels of analysis: iconic (the actual plastic dimension), iconography (pictorial conventions that permit identification, and iconology (the worldview that underlies image). This third level allows one to relate works with the "*symbolic forms*" of a society, (Heinch 2002, 14). However, this particular method is more appropriate for the analysis of more figurative images.

For contemporary visual culture theorist, Nicholas Mirzoeff, semiotics, or the science of signs, is a system created by linguists to analyze the oral and written word. It divides the sign into two parts: the signifier—what can be seen—and the significance—what it means (…). Semiotics got his strength by denying any necessary causal relationship between the two aspects of the sign. Mirzoeff exemplified this, using the drawing of a tree, which is made in order to understand what a tree is, not because in any certain way it is really like a tree, but because the audience who observes it, accepts it as the representation of a tree. Therefore, cites Mirzoeff (2003, 34): "*It is possible that these modes of representation will change over time or that they will be challenged by other means of representation. In short, seeing is not believing, but interpreting. Visual images succeed or fail insofar as we can interpret them satisfactorily.*" We must be able to successfully interpret the language of painting and the language of architecture.

6 Teaching Experience

Over the past nine years, in the courses of Design Principles, in the School of Architecture at the University of Costa Rica, work has been taking place on the exploration and development of ways for learning project processes, based on analysis of the compositional principles of abstract geometric work. It starts with the understanding of the basic design principles developed by researchers such as Attilio Marcolli (1978), Wong (1982), and Ching (1975), among others.

From Ching (1975), the following concepts are discussed:

– Primary elements: point, line, plane, and volume
– Form and space
– Principles of order
– Spacial organizations.

From Marcolli (1978), the concept of field theory is explored, especially in the intuitive geometric field from which want to learn concepts such as:

– Structure
– Composition of objects
– Connection between surface and object
– Color as a sign.

The following design elements raised by Wong (1982, 11) are further developed:

– Conceptual elements: point, line, plane and volume
– Visual elements: shape, size, color, and texture
– Related elements: direction, position, space, and gravity
– Practical elements: representation, meaning and function.

The exercises are divided into two units called Design Basics 1 and 2, which are structured into four months each, with weekly sessions of 3 h. This paper presents only the first unit because it deals with exercises that are directly linked to the processes of geometric abstraction and their subsequent interpretation as a tri-dimensional basis for spacial solutions in Design. These become the basis for courses in design workshops.

7 Modules Guide for Design Principles 1

- **Perception of form**: This module focuses on the factors influencing perception and the meanings of forms based on a composition built on the basis of principles of geometric structure in the field study.

Exercises: Fig. 1 (photography by author).

- Composición bidimensional de tramas a partir de planos básicos.
- Introducción a las rotaciones de la forma.
- Generación de ejercicios tridimensionales en rotación.
- Bi-dimensional composition of frames based on basic planes.
- Introduction to rotations of the form.
- Tri-dimensional rotation exercises.
- **Principles of bi-dimensional form and space**: Analysis of the basic visual properties of the form and its compositional rules: contour, size, color, texture, position, orientation and visual inertia.

Properties of basic planes, associative additions and subtractions of volumes.

Color: definitions, characteristics and symbolic application.

Modifying the perception of compositions by emergence of virtual planes through the use of color.

Exercises: Figs. 2 and 3 (photography by author).

- Composition dimensional, painted with basic plans (lines, planes, side flat, empty—full relationship, stress approach, partnership and complete differentiation, polychrome, and/or formal.
- Generation flat composite sequences, addition and subtraction and side spaces, through linkages, footprints, thresholds, bridges, connections, enclosure, opening impact, radiation etc.

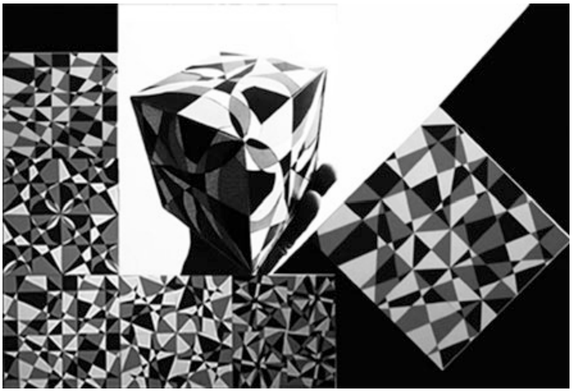

Fig. 1 Monochromatic geometrical composition

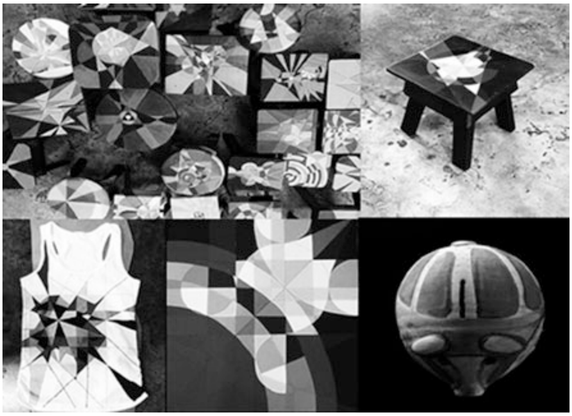

Fig. 2 Polychromatic geometrical composition

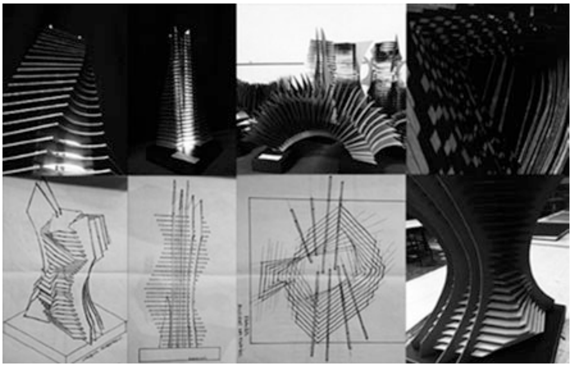

Fig. 3 Three-dimensional composition of serial planes

– **Principles of tri-dimensional organization**: Qualities of three-dimensional plastic composition, external shape, internal shape, closed forms and open forms. Visual structure of plastic composition, sequential organization, full and empty forms, associated forms, and tridimensional plots.

Proportion, rhythm, and plastic balance. The importance of line and plane in the volumetric composition (links). Analysis of the incidence of light as an ethereal compositional element.

Exercises: Figs. 4 and 5 (photography by author).

– Polychrome dimensional composition and basic volumes (sphere, cube, tetrahedron and secondary variants, cylinder, parallelepiped forms, pyramids, cones etc.)
– Differentiation of primary, secondary and tertiary spaces generated by the voids between the shape.

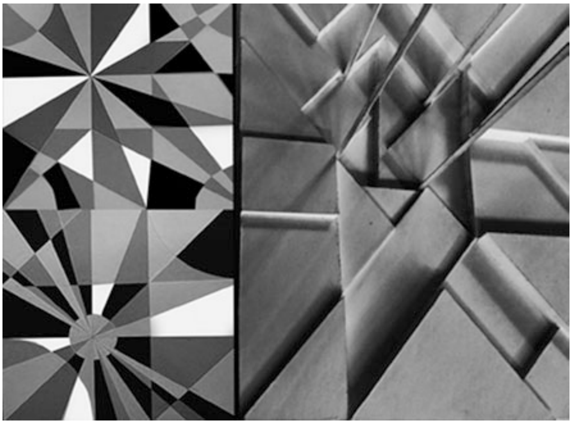

Fig. 4 Bidimensional composition as the basis for construction of three-dimensional model

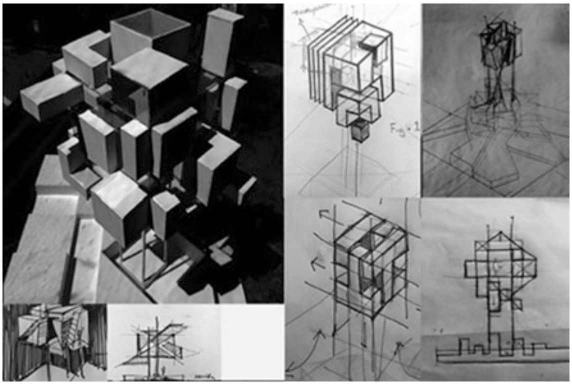

Fig. 5 Composition volumes

- Plastic and significant composition.
- **Principles of spatial organization**: Identification and application of the properties and principles of spacial order: hierarchy, rhythm, scale, pattern, proportion, ordered pattern, balance, etc. for the purpose of expressing an emotional space component. Connectivity between spaces: contiguous, related, indoors, outdoors. Basic spacial organization patterns: centrality, radiality, linearity, group, frame, polarities, etc. Enclosure and spatial characteristics, physical and virtual openings.

Exercises: Figs. 6, 7, 8 and 9 (photography by author).

- Identification of tridimensional frames, based on analytical knowledge of the platonic solids applied to a specific topic.
- Development of proposed analytical model and polychromatic planimetry.

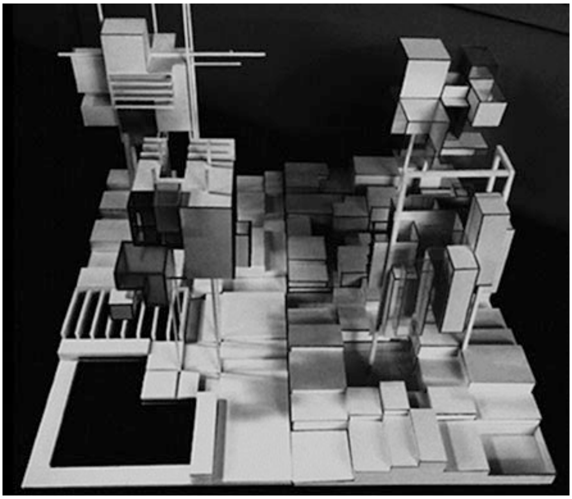

Fig. 6 Perspective view of the composition of volumes

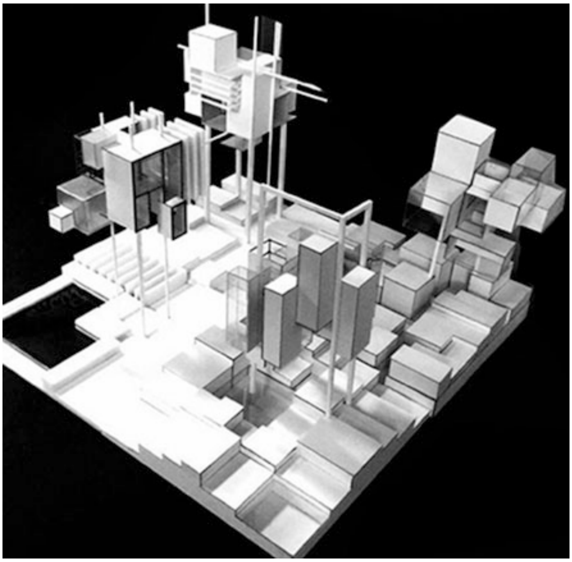

Fig. 7 Lateral perspective view

8 Conclusion

The interpretation and basic knowledge of the management of bi-dimensional shapes based on abstract geometric compositions and their subsequent realization in tri-dimensional elements seeks to find a practical application through exercises, this being the basis of the training exercises to complement the exercises in design and the development of creative qualities. In this way, the form is not determined only

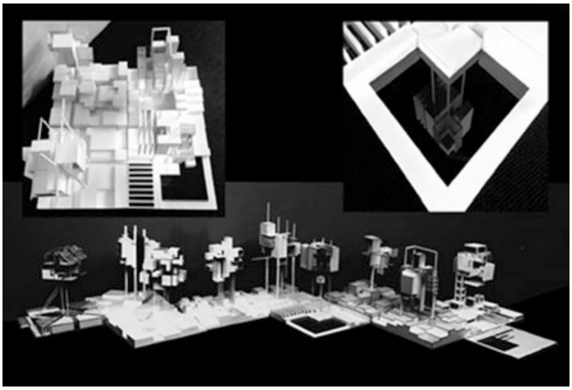

Fig. 8 Lateral perspective view

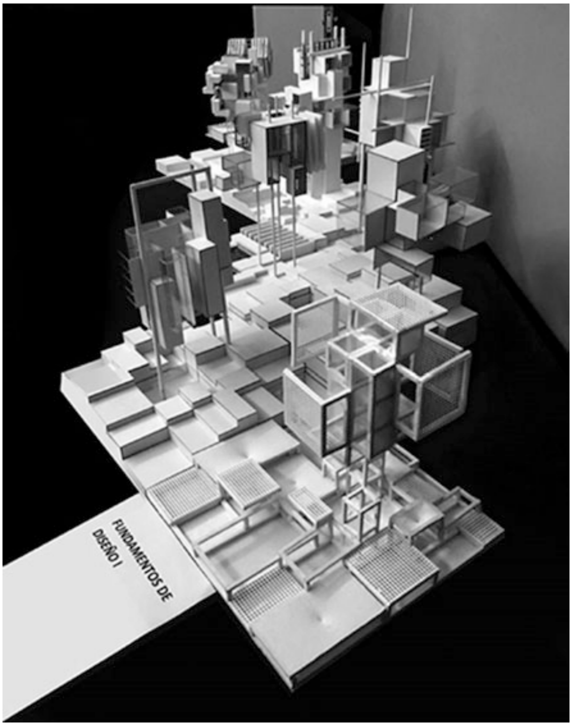

Fig. 9 Frontal composition perspective view

by the physical properties of the material, but also by the style of representation of a culture or by an artist that produces it. This is where the context becomes important, not only of who produces the artwork, but also of the public that receives it. The academic experience and teaching of the topic of abstraction presented in this paper has been developed and presented in the University of Costa Rica as well as in the

University Of San Carlos Of Guatemala, and as a visiting researcher at the University of Guadalajara in Jalisco, Mexico (Fig. 10).

We are in the century of the image, quoting the author, Schechner (2012, 22), who says that absolutely anything can be studied as representation. *The "artistic practices", he says, are developed at the forefront, and their representation issues are actions, both disciplines working mainly with ideas (conceptual art), where the speech text is its main contribution. Can the plastic exploration exercises of the architect be considered an art or "art practice"? Kandinsky said that "in the abstract art, the "Objective" element reduced to a minimum should be recognized as the most powerful real element".* (1912, 22) So, the use of bi-dimensional representations of abstract geometries have already been used in the past as design tools in Neoplasticism as well as in modern art and architecture. Therefore, it is no coincidence that the rise of postmodern art and architecture coincide with the end of abstract art in the early seventies. ¿Given the possibility of a depletion of the "contemporary art practices", we will be at the gates of a resurgence of a "neo-abstraction" in art and architecture? To what extent has the era of technological expertise been whittling away at the original link between art and architecture?

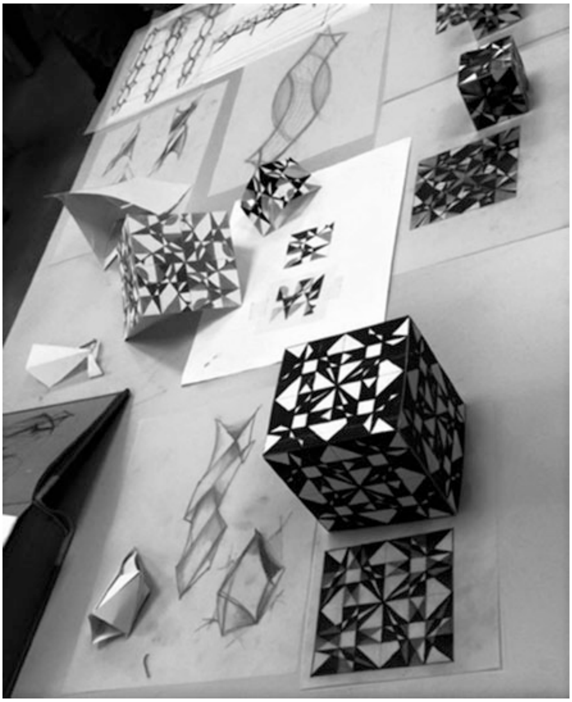

Fig. 10 Workshop exercises at the University of Guadalajara

Textual References (in order of appearance)

Zapelli (2003) “La humanidad empieza a conocerse a partir de los rastros dejados por su propio cuerpo: huellas (Read, 1954:31). ¿Es este protoarte del origen una primera focalización de lenguaje artefacto, un lenguaje artístico?” My translation.

Zapelli (2003). “La primera forma de escritura toma el nombre de “mitográfica” (4000/3000 años a.C.: sumerios y egipcios). En esta etapa, el ser humano aprende a recordar por medio de la grabación semiográfica. Pero la escritura mitográfica no es suficiente para registrar significados más generales y, por ello, se empieza a juntar los signos pictográficos en series combinables para establecer conceptos.” My translation.

Arnheim (1986). “Los simples dibujos lineales pueden dar forma visible a las configuraciones de fuerzas y otras características estructurales”. My translation.

Arnheim (1986). “En el sentido más estricto, es quizás imposible que un objeto visual no sea sino un signo… En la medida en que las imágenes sean signo pueden servir solo como medios indirectos, porque operan como meras referencias a las cosas que denotan”. My translation.

Arnheim (1986). “Las imágenes son representaciones en la medida que retratan cosas situadas a un nivel de abstracción más bajo que ellas mismas, cumplen su función mediante la captación y evidenciación de alguna cualidad pertinente –forma, color, movimiento– de los objetos o actividades que describen. Las representaciones no pueden ser meras replicas, esto es, copias fieles que solo se diferencian del modelo por imperfecciones casuales” My translation.

Arnheim (1986). “Un símbolo concede forma particular a tipos de cosa o constelaciones de fuerzas. Toda imagen es, por supuesto, una cosa particular y, al referirse a un tipo determinado de cosa, sirve como símbolo, por ejemplo, si presenta un perro con el objeto de mostrar en qué consiste el concepto del perro. En principio, todo espécimen o réplica de un espécimen puede servir como símbolo si alguien decide utilizarlo con ese fin. Pero, en tales casos, la imagen deja por cuenta del usuario el esfuerzo de llevar a cabo la abstracción” My translation.

Jaramillo (2004). “la capacidad de almacenar o guardar recuerdos inmediatos o tardíos” My translation.

Jaramillo (2004). “la capacidad de comprender y de aprender, o de pensar en abstracto que tienen las personas” My translation.

Fonatti (1988). “La conciencia no es equivalente a la conciencia ni a la razón. La inteligencia es el instrumento de la razón. La conciencia es la suma del entendimiento humano. La inteligencia en el sentido más estricto, es la facultad de crear imágenes (representaciones) mentales a partir de las percepciones de los sentidos y la capacidad de convertir dichas imágenes, a través de una abstracción, en ideas que habrán de asociarse a la hora de emitir un juicio o de sacar una conclusión”. My translation.

Dávalos, Raffta (2009). “Por ello hay que mirar un poco hacia atrás, cuando se era niño, para dar cuenta de cómo se ha puesto en práctica y cómo ha evolucionado el dibujo y la geometría a lo largo de la vida de las personas, incluso las diversas herramientas utilizadas en cada una de sus etapas”. My translation.

Mirzoeff (2003) “En periodos anteriores, se debatía si las imágenes visuales parecían reales porque verdaderamente se asemejaba a lo real o porque representaban con éxito la realidad”. My translation.

Mirzoeff (2003) “Las imágenes no se definen por una cierta afinidad mágica hacia lo real, sino por su capacidad para crear lo que Roland Barthes denomino el “efecto realidad”. Las imágenes utilizan determinados modos de representación que nos convencen de que son lo suficientemente verosímiles para acabar con nuestra desconfianza”. My translation.

Mirzoeff (2003) “probar y dar sentido a la variedad infinita de la realidad exterior mediante la selección, interpretación y representación de dicha realidad”. My translation.

Arnheim (2002). “Yo siempre busco el parecido”, declaraba el pintor en 1966; y exclamaba que el artista debe observar la naturaleza, pero no confundirla nunca con la pintura: “solo es traducible a pintura mediante signos”. My translation.

Arnheim (2002). “Lo dicho vale igualmente para el arte “abstracto” o no mimético. Media un abismo entre que en una pintura abstracta veamos una disposición de meras formas, esto es, de objetos visuales que puedan ser totalmente descritos por su área, silueta, color, ubicación, etcétera, y que en lugar de eso veamos la acción organizada de unas fuerzas visuales expresivas. En este último caso, las formas se eclipsan tras el juego dinámico, y es solo ese juego el que trasmite el sentido de la obra”. My translation.

Dávalos, Raffta (2009). “Abstraer es una operación mental que consiste en separar algo de un contenido determinado, es decir una característica de un todo determinado, Aristóteles considera que separamos la forma o la esencia de la materia lo cual nos permite formar conceptos”. My translation.

Arnheim (1986) “Si el pensamiento tiene lugar en el reino de las imágenes, muchas de esas imágenes tienen que ser altamente abstractas, pues la mente opera a menudo a elevados niveles de abstracción. Pero, llegar a estas imágenes, no es fácil”. My translation.

Arnheim (2002). “(…) en ciertas condiciones naturales, un arte más realista no serviría mejor al propósito del artista, antes bien lo obstaculizaría”. My translation.

Mirzoeff (2003). “Las partes constituyentes de la cultura visual, no están por tanto definidas por el medio, sino por la interacción entre el espectador y lo que mira u observa”. My translation.

Torres (2010) “(…) estamos recopilando información y adquiriendo destrezas e infinitas posibilidades graficas expresivas; en definitiva, nos convertimos en personas visualmente alfabetizadas”. My translation.

Torres (2010) “obtener un vocabulario específicamente gráfico; son los elementos básicos visuales, como el punto, la línea, el contorno, dirección, tono, textura, dimensión, escala y movimiento, los que nos ayudarán a comprender y analizar la estructura total del lenguaje”. My translation.

Aicher, Krampen (1991). “La comunicación a través de imágenes se ve envuelta en una magia especial (…) ¿La comunicación a través de imágenes tiene ventajas de la comunicación por medio de palabras?” My translation.

Mitchell (2009). “Podríamos querer decir que el autoconocimiento es “solo una metáfora”, cuando se trata de imágenes que, después de todo, no son sino solo líneas, formas y colores sobre una superficie plana”. Pero también, sabemos que las imágenes han sido siempre más que eso; también han sido ídolos, fetiches, espejos mágicos: objetos que no solo parecen tener presencia, sino también, “vida” propia, que nos hablan y nos devuelven la mirada. Por eso es que utilizar las metaimágenes como instrumentos para entender las imágenes, parece poner en entredicho el conocimiento del observador”. My translation.

Mirzoeff (2003). “Es posible que los modos de representación cambien con el tiempo o sean desafiados por otros medios de representación. En resumen: ver no es creer, sino interpretar. Las imágenes visuales tienen éxito o fracasan en la medida en que podamos interpretarlas satisfactoriamente”. My translation.

Schechner (2012) “(…) absolutamente cualquier cosa puede ser estudiada como representación. Las “prácticas artísticas”, señala, se desarrollan en la vanguardia y sus temas de representación son acciones, en tanto disciplinas que trabajan principalmente con ideas (arte conceptual), donde el discurso del texto es su principal aporte”. My translation.

Kandinsky (1912) “En el arte abstracto, el elemento “objetivo” reducido al mínimo debe ser reconocido como el elemento real más poderoso”. My translation.

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From the Atelier to the Personal Trainer App

Fernando Lancho Alvarado

Abstract Formal education was based on the imitation of models. The *avant-garde* artistic movements were built in opposition to this system and did a great job of demolition. With a current perspective, we can revise the tradition, without prejudice, in search of topics that the modern movement felt outdated and which however can be useful. The postmodern recovery reissues the past according to the contemporary way of proceeding. The strategy often makes use of contemporary technologies. This presentation designs a Personal Trainer App to start drawing, using imitation as a strategy.

Keywords Sketch · Learning · Imitation

1 Some Background on Imitation and Originality

Artistic originality is an aspiration of Romanticism and since then has established itself as an artist's value. Progressive late 19th-education seeks the self-development of a person. At that time, psychology is beginning to apply to education and starts to investigate the genuine intellectual growth (Montessori 1912) (Dewey and Dewey 1915). But it's not until the end of First World War when education, in search of social reconstruction, finds in the child a new future and his immaculate originality is once again a great value. A child who is born without references to mistakes, using his expressive originality can, with the best of his intentions, bring back a deteriorated social climate. The aim is free expression, the neonatal singularity. Artists guardians are personally responsible for awakening the creative originality that is within the child, but they do not find it, as the child has to learn it first. But up to the 19th century, this never happened. Art was based on

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tradition and the lessons of masters who did not seek for the apprentice's originality, but rather just transmitted what they knew. Apprentices aspired, in any case, to draw as good as the master of their workshop. Not even the great geniuses of the Renaissance sought originality against their teachers, only pursued to overcome them, but with the same way of drawing as their instructors. The best of them all, Leonardo, is a good example. When you see *Woman's head* for the first time, you immediately think it's a Leonardo's drawing, that's the way Leonardo drew (Figs. 1 and 2).

But *Woman's head* is a drawing of his teacher, Andrea Verrocchio. Leonardo's graphic mimicking is extraordinary as befits the best disciple. It is difficult sometimes to distinguish them, *Woman's head*, maintains the experts on the question of which of the two was the author. Leonardo joined Verocchio's workshop as an apprentice at the age of 17, and continued to work there until he was 24 years old. Although the last years he came in and went out the workshop in a more independent way, he continued to collaborate with his beloved teacher until his death. For seven years they worked together hand in hand, collaborating in the work of the workshop. Leonardo learned to draw in the process, the action was happening in front of him, he learned from pure imitation.

When the great artists of the Renaissance had already disappeared and seeing that nobody new could take his place, Vasari founded the Academy en1562. The training system was inspired by what seems to be advices from Leonardo himself who recommended in some annotations: "first of all, copy drawings made by a

Fig. 1 *Woman's Head*, Verrocchio

Fig. 2 *Woman's Head*, pending attribution

good teacher from the nature and not as exercises; then, copy from a relief, having near a drawing made from the same relief; then one made from a good model; and all of this should serve as a practice" (Melzi 1651). Vasari acquired a collection of drawings made by the great masters, mostly from his good friend Miguel Angel, the only one of them who was still alive. Leonardo and Raphael had already died, but their memories were assured thanks to his biographical works (Vasari [1550] 1568). He had drawings and the biographies of the most important artists and with those data Vasari founded the Academy.

The educational model which he established in the Academy was transcendental, since then, all the institutions dedicated to artistic teaching, have used the same method: copying of drawings, utilizing plaster and using nude models. It doesn't look like a bad method, that's the way Ingres learned and so did many others who achieved remarkable levels of skill, but, could it have been otherwise? Nobody seemed to had questioned it until the end of the 19th century when the artistic vanguards began to take shape in the *ateliers*. The ateliers were still teaching with the same system and the fortuitous decision to start painting outdoors triggered, naturally, the great change in painting. But even after this, academic institutions have followed the Vasari method used until the last third of the 20th century.

2 Present Situation

In the light of what we know today about cognition there are certain questions in the academic method that aren't being properly addressed. The drawing of nude models, even if they are made by great artists, is not capable of producing effective learning by itself. A drawing is the result of drawing and is precisely to draw what is pursued. The successive operations during the process of drawing: attempts, rectifications, appraisals, time, speed, technique, format and an endless stream of decisions belong to the process. The observation of a finished drawing doesn't reveal that process to a neophyte and that is precisely what the learner needs to know. Leonardo saw his master draw for many years, they drew together on the same surface the transmission of the process was ensured and that was what happened. The drawing is not the most suitable educational material but how it's drawn, the action itself.

Vasari draw very well, it is possible that he drew with his apprentices as so did others in front of the people who wanted to learn how to do it, but the hierarchical system of academies did not consider this testimony as essential. We have all had a drawing teacher whom we never saw drawing. We learned such transcendental lessons as walking or talking by imitation. We witnessed, we were surrounded by people who did it continuously around us, we saw them do it and started to imitate them until the results were adequate. Why don't we learn to draw the same way? No one has invented a personal way of walking or talking, those are models that we have taken (Piajet, Vygotsky, Bruner and others). Wherever we get with our own steps, our words or our drawings belongs to our unique destination but we can not invent certain things at the beginning, when we are learning them. The gateway of learning is almost always the imitation. Piaget studied carefully these processes of imitation in the child and considered that imitation is a manifestation of the intelligence.

The constructionists opened a path that has not stopped growing, the application of these theories has improved learning. Cognitive psychology works inside of what is called the cognitive hexagon: neuroscience, artificial intelligence, psychology, linguistics, anthropology, and philosophy. The development of its theories has a close relationship with the development of computers: ultimately, artificial intelligence aims to mimic our own intelligence. In the last forty years the events in this area have changed our conceptions about learning. The creation of hypertext made possible the first global network project: Xanadu (Nelson 1970). The first personal computers emerged in 1977 and the Xanadu dream took shape as the World Wide Web in 1981. The *hypermedia* or *hypertext* continued progressing, expanding its possibilities (Landow 1997) until 2004, when a new way to interact online appeared: collaborative platforms, known as WEB 2.0. Now we can not only share knowledge in a better way, but also participate in its cogeneration.

The impact this has on learning is evident, there is many educational research focused on the new possibilities of self-learning in the Web. It seems like technology progresses faster than humanities, however, the publication of Rhizome

(Deleuze and Guattari 1977) invited us, from philosophy, to join the advent just after it occurred. Access to information has changed, it is now quick, *wiki*[1]and universal like the Illustration dreamed. But now you can also interact, collaborate in the construct of the rhizome, we are talking about a new way of learning based on the access to information. No progress so far has had such an influence in the possibilities of developing our intelligence. Now the educational world releases a new tool every day, assesses their potential and proposes new ways to generate learning with it. This presentation does exactly that, aims to improve the learning of drawing investigating the possibilities of these new resources and it does it by attending the apprentice precisely in that hidden area of the picture that is how to draw it. Our goal is to make visible the action of drawing accompanying the apprentice's drawing with our own drawing simultaneously, using some of the new tools available.

3 The App's Design

The experience of drawing is too extensive to pretend to cover it in a single exercise. We will have to divide it into smaller parts, as many as possible. This is a strategy of the computer that mimics our neural indexing. Each fragment of the drawing experience should be a compressible unit and can drive to an apprentice. The smaller the fragment, the higher its effectiveness. Education refers to this as *information pills.*

Initiation to drawing is always the most delicate step: failure, frustration, prejudices, misconceptions and unreasonable goals, everything binds together and produces a lock that must be dissolved.

In DAI[2] workshops we know of this and have unblocking strategies which we use at the beginning of the program. The workshop where we currently develop this task is formed by: Pedro Burgaleta as an expert apprentice, Ivan Pajares and I as senior trainees and about 65 junior apprentices per course. For the last three years we have developed a special activity to initiate apprentices in drawing, and we do so by using Giacometti's drawings. Learning to draw generically is surely impossible. Therefore, until the learner develops his own way of drawing, it seems advisable to resort to appropriate cultural references that can serve as an example.

Giacometti's way of drawing, shown as a recognizable and accessible procedure which is based on sounding out, constitutes an important reference to learn how to draw. "Indeed, the attitude of Giacometti is a continuous exploration of the shaping process which is never declared over, showing an attitude of openness and self learning that could be exemplary" (Burgaleta 2012).

[1]*Wiki*: from hawaiian *wiki*, "fast".

[2]DAI: Dibujo, Análisis e Ideación (Drawing, Analizing and Planning). Graphic subject, first year, ETSAM.

Fig. 3 Detail and *Diego's Head* (1962). Giacometti

His drawing process is easily recognizable, his graphical exploration doesn't use skill but a personal way of accumulating lines postponing the results. You can draw Giacometti as soon as you start if you observe some simple rules that are basic in any draw (Fig. 3).

If we compare *Woman's Head* by Verrocchio with the heads drawn by Giacometti, it is clear that the apprentice's artwork will be closer to this last one. Constructivist Learning uses what has been learned as a base to induce new learnings. In our case we consider scribbling as something previously learned. Scribbling is within the reach of everyone, it does not require skill, just disinhibition. It is a basic and infant sensorimotor experience, but how can we transform scribbling into productive drawing? That is precisely Giacometti's contribution. It is a laid back flowing of lines that add up with no hurry whatsoever. Lines are never accurate, they doubt and go wrong but they're all are useful and their accumulation ends up producing a sensation of effectiveness. We, in class, call this *the skein of lines*. Despite the immediacy of these drawings, the process hides information that is essential to reveal: the order and above all, the intention of the lines. Here is when technology can be useful.

Apprentices with their DIN A4 drawing notebooks and some simple instruments, which they normally work with, like a fine sharpie or pen, sit in front of the projection screen. For this training we use *Procreate*.[3] On the left side of the screen

[3]*Procreate*: iPad's exclusive ilustratión application. Desarrollador: Savage Interactive Pty Ltd. Versión 2.3 actualizada el 24/04/2015.

we find the finished original drawing to be duplicated. On the right, one of the professors will draw the model emulating Giacometti's process. He draws at the same time as the apprentice to facilitate the imitation. While everybody draws, the verbal remarks of the rest of the teachers complete the work environment. In the first attempt, well thought drawings start to appear. In one session, almost everyone has already learned to proceed and the results are very satisfactory.

The journey of drawing is long, apprentices are told that they will need ten years of daily practice to reach the professional mastery, but we have opened a door and they already feel inside. They have a procedure to face any reality by drawing it, they are autonomous and can practice wherever they want and with whatever model they choose.[4]

The method is very effective, in two sessions of two hours we get the expected results. Despite this, the recent changes in the education system make every hour of class really valuable. Making good use of the time in the workshop is essential. And what would happen if we could exclude it from the class time? If we packed them into a product Web 2.0, in an App,[5] trainees could practice without the need of using the workshop. An independent initiation, accessible to anyone who needs it, that can be adapted to their own personal learning pace. Transferring learning outside the classroom is an educational project that has taken shape under the name of *Flipped Classroom*.[6]

These projects analyze the available IT resources to extract, from the on-site class, matters that do not require our direct presence, offering more autonomy to the apprentice (Fig. 4).

To transform the experience "drawing as Giacometti" into a product *Flipped Classroom* we already have most of the work done. We are already digitally producing the event in the workshop, we just have to solve how to encode values as: company, motivation, useful information at the relevant time, critical reflection and the emotional management of the event.

All this material has to be written with the dual possibility of being read or put into a video. To produce all this textual information, we have to first divide it into three general categories: information, instruction and emotional management. These categories are further subdivided in various levels. The intention is to divide the information into very short text packages. To reconnect these packages we use *Hypertext* by introducing link words inside each package when necessary. The treatment of each category is different. The information admits a lot of hypertextuality. A discrete menu with links allows you to dig deeper into the concepts if you want to. The directions, however, should be clear and visible. A link to the general rules of use of the app (game rules) and specific norms for each stage will appear on

[4]Student's works using Giacometti's method compilatión in https://barrachunky.wordpress.com/tag/giacometti/ 14/08/2015. 17:10.

[5]App: Informatical application designed to make different types of work.

[6]*Flipped Classroom* Official blog: http://www.thefl. Community: https://plus.google.com/u/0/communities/109884545472617380981.

Fig. 4 Apprentices' drawings, outside the workshop, after training

screen when necessary. Finally, the emotional management will mainly use the audio format, with the option of silencing the commands when there are no longer necessary. This category is mainly aimed to restore the human relationship of the workshop. Encoding this emotional language is a contradiction because in the workshop it emerges from the spontaneity of the speech. Although the apprentice hears the recognizable voice of one of his professors, the message loses freshness, its analog nature becomes a digital message (Luxán and Lancho 2012).

The action of drawing should not last more than ten minutes if reproduced without interruptions. This timing can be increased by the use of hypertext or by the deviation of the process, advising to start the drawing again at some intermediate stage.

There are programs that capture everything that happens on the screen of a computer in video format.[7] This way, using the Procreate App, we can capture the entire process. But it's necessary to resort to more versatile programs in order to introduce text packages. For our project we use *Camtasia,*[8] which allows us to edit the screenshots, and *eduCanon*[9] to introduce audiovisual packages at appropriate times and, something really important, interactivity with the apprentice.

Within the timeline we situate some of the action's control points, posing multiple-choice test questions. For example: How is that process going? Compare your drawing with the guiding drawing. Check if you detect any of these errors: 1 Some areas are very elaborated and others not so much, 2 There are some excessively strong strokes, 3 Some lines seem particularly aimed to find the outline.

[7]Screener: (http://www.screenr.com/), ScreenToaster: (http://www.screentoaster.com), Screencastomatic: (http://www.screencast-o-matic.com/) and others.

[8]*Camtasia:* http://www.techsmith.com/camtasia.html.

[9]*eduCanon:* https://www.educanon.com/ Is an online learning environment to create and share interactive video lessons.

4. Many short strokes in the same area. 5. The situation of the drawing in the paper or its size are very different. These questions replace the control process that takes place in the workshop. But the most important part of these questions is that they train the self-critical view and activate basic attitudes that the artist must keep.

If some error is detected and marked, a piece of advice will appear: It seems that your drawing is not following a good process. It might not become a good drawing. I recommend you to start it over again, don't worry, this is normal at the beginning, next time will be much better, it's a matter of practice. Aiming to cross these checkpoints successfully, the apprentice will be alert and will train its attitude during the process.

There are two aspects of great importance to the physiognomy of imitation. When we draw we move the arm, hand, head and eyes in a special way, adapted to the action. The hand flows expertly like a craftsman: delicate, constant, exploratory and executive. The neck moves the head very quickly and often to look alternately to both the model and the paper. It is common seeing the apprentice becoming absorbed by his own drawing and forgetting to compare it with the model, because he still does not understand the binding data are in the model, and neglects it. The apprentice has to learn to move both his head and hand, so it's also necessary to *flipp* this. We have to shoot some scenes that show these movements in an expert. *Camtasia* allows to overlay additional video windows that roll simultaneously on the general video that can be given different degrees of transparency. This belongs to the Information category, and appropriate duration, location, and size must be chosen.

4 Conclusions

There is a lot of multimedia material in the *network* dedicated to teach the multiple aspects of drawing, but most of them haven't thought too much about how we actually learn. If they don't do this, their effects will increase the frustration of the person who wants to learn.

In our schools we have the necessary educational skills, but we don't have enough time to achieve great results. Technology provides tools with educational possibilities, but a critical reflection and educational skills are needed to make a good use of them. Someone might think that Web 2.0 education can supplant the teaching activity, but its utilization shows otherwise, it's an educational supplement that complements our work. Routines, explanations, speeches, lectures, or any other act that is repeated year after year are activities that take time from experiential learning. Workshops are the place of shared actions, so if we are able to outsource some instructions, we will have more time. New possibilities, new ways of making and new options open to learn.

A teacher no longer has to just keep up to date with his own subject, but also needs to pay attention to the development of educational technology and participate actively in its application. The research should not only discipline, but also generate educational research on the implementation of new technologies and the possibilities they offer us. This informatic personal training app (*Personal Trainer App*) is an example.

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A New Academic Realm: Video-Game Enrols in College

Eduardo Roig and Nieves Mestre

Abstract The format of video game seems revealing to explore a number of architectural phenomena: the architect is nowadays actively enrolled in the construction of interactive digital places as part of extensive multidisciplinary work teams. Originally linked to military experiments and computer labs, video game gender is rather implied on research and academic teaching-learning literature. The number of university programs considering this subject an issue beyond technological gadgets or mere entertainment has exponentially increased. The purpose of this communication is advancing in the emergence of a video games pedagogy promoting its inclusion in architecture university curricula. This paper proposes a topological analysis of the video game with a clear pedagogical intention to structure a hypothetical video game undergraduate course, preferably under the field of knowledge of design ideation and graphics.

Keywords Videogames · Architecture · Gameplay · Cybernetic · Google glass

1 An Architectural Approach to Cybernetics of Cyberspace: Video Games Versus Augmented City

The building process of the *augmented city* overlaps the digital layer with the traditional city (Roig 2013: 3). In this city of contemporary future, interaction between citizens and cybernetic systems happens in multidimensional-experience layers. Augmented environments powered by electronic devices such as Google Glasses, define a technologically mediated reality where the digital interface enables participation and user navigation. The room, the street, the car windshield,

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the mobile phone, … etc. all become supports of different scenarios close to those modelled by the video game industry. The inclusion of player feedback into the system implied in the cybernetic order is a research field whose attributes can be potentially transferred to the design of future cities *technoplaces*. Video games perform as real laboratories where physical-digital dual nature is tested since the mid-twentieth century. The capability of motion the user-player displays at video games is one of the main issues explored in this paper.

This research therefore focuses mainly on video games, but also aspires to be casted into the *augmented city*, a phenomena that should not lack in the design competences assumed by contemporary architects. Similarly recent BA academic programs on video game design incorporate topics such as History of art, Artistic drawing, 3D modelling, Physics fundamentals, Design studio, etc. Moreover, video game studies enrol more and more experts to enlighten the diverse attentions fitted in this playful format. Academic specialists as Aarseth (2001, 2007), Bogost (2007), Consalvo and Dutton (2007) and Murray (1997) propose reflections on the concept of *gameplay*; *gamification*; user psychological effects; aesthetics; gender, in and out of the screen, etc. Video games theory is often coming from disciplines that at first glance may seem disconnected to digital media; but if we understand this format as another information media, it is clear that the disciplines involved are increasing in quantity and diversity—let the reader think on educational back ground of some movie critics. In that case, how an architectural theory of the video game could be structured? Which variables could be analysed by that architectural criteria? What evidences could move from architectural approaches towards cyberspace architectonics?

The vector-based scenarios of computer games are not very different from the digital models produced by architectural design. The characteristic protocols of a video game engine are very similar to those integrated by Computer Aid Design software (CAD).

Interdisciplinary exchange is ready. That's the point of view of editors Von Borries et al. (2007) in *Space Time Play*, compilation of articles about the aforementioned disciplinary convergence whose argument is aimed to be continued in this text.

2 Google Glass Digital Mediation at the Augmented City

Not by chance the terms 'cyberspace' and 'government' share a common Greek etymology (DRAE): *kibernetes* (ship pilot) or *kibernetike* (art or technique of piloting a ship) are both referred to motion control. The *Hippie* cyberspace coined by William Gibson at *Neuromancer* (1984) was revealed as a virtual world open to imagination and daydreaming. Despite a great social opposition, this cyberpunk reference resigned in 1998 to the strong dictations of the *World Wide Web*. Cyberspace saw how its original configuration was replaced by a very rigid architectonic interface which, in order to simplify its governance, imposed a hieratic confinement inside the screen based on a solipsistic and offish design. The control of cyberspace navigation is actually one of the qualities permitting the inhabitation of virtual worlds (López-Galiacho 2014). In analogy with the action of urban strolling or 'browsing a building', it is worthy to investigate this cyberspace navigation from an architectural point of view.

The nature of digitally augmented environments (Fig. 1), as proposed by the Google Glass industry (Fig. 2), is based on the navigation control by a digital layer geo-located by *locative media* (Fig. 3). Let's invite the reader to remember *Terminator'*s eyes: imagine yourself in places where the digital perception is merged with your biological perception; places where record sounds located at digital beacons and electronic-based visual information are perceived—without detracting from other less-common senses in our audio-visually dominated era.

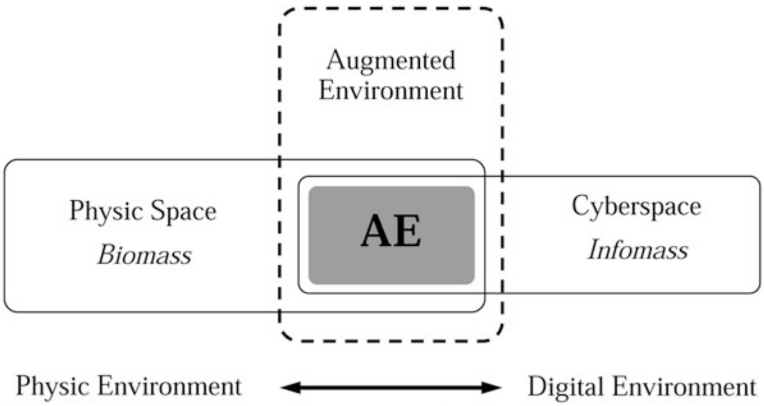

Fig. 1 *Ontology of the Augmented Environment,* E. Roig

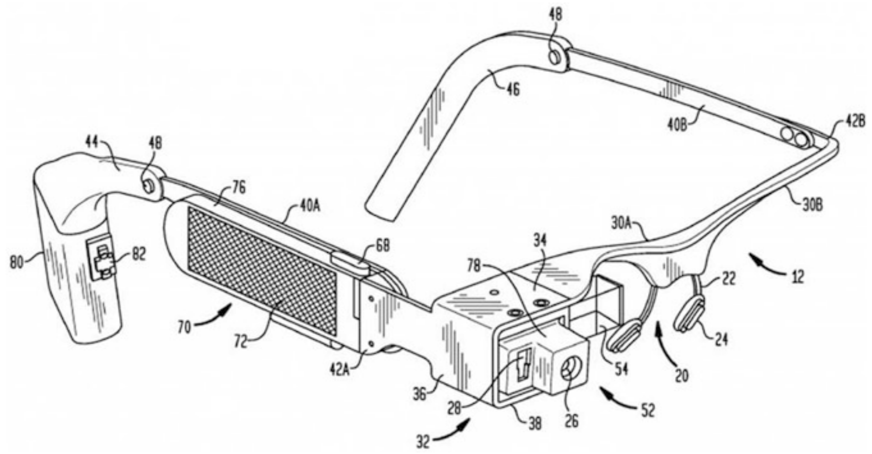

Fig. 2 *Google Glass* Design Patent. US Patent and Trademark Office via Engadget

Fig. 3 *Domestic/City*, p. 13. Keiichi Matsuda. Available at: http://www.keiichimatsuda.com/kmatsuda_domesti-city.pdf

As already suggested, the construction of the *augmented city* requires interdisciplinary collaboration between computation and architecture for the design of the digital interface and the link between it and the historic city. It is therefore necessary to extend the current competences of the architect from these embryonic moments, for his urgent inclusion into the development of this important episode.

The augmented landscape generated by the aforementioned electronic glasses, sets a mediated and technologically tagged reality—still in a rudimentary state, similar to that inaugurated by the first video games. This genre becomes an experimental field whose attributes, highly architecturally diverse, are likely to be taken towards the design of the *tecnoplaces* building the *augmented city* up. In there the user can move simultaneously in both a digital and physical environment (Fig. 4) as his dimensional/communicative/informational extension becomes hybrid. In cybernetic terms, it can be argued that the *augmented city* consumer inhabits those places like surfing inside a video game. The monitored landscape of the *augmented city* is electronically-sensible to the citizen through a real ecosystem of sensors able to register any data taking place—continuing with the cinematographic metaphor, it comes the turn of *Big Brother* (Orwell 1949). At the opposite side of the communication chain, the user of this technologically mediated city could tune both its porosity—100% in *Matrix* (Wachowski Brothers 1999)—its perceivable or apperceived format, or the kind of available access towards the digital layer.

Nowadays, the inclusion of the parameter of 'time' inside the building project design becomes an attention that many architectural offices perform, often coming from the Paradigm of Sustainability. The video game presents a playable format that enables user interaction and introduces this variable in the digital *re-presentation of gamespace*. Those computer games that also overlap its graphical interface

Fig. 4 *Augmented City*. Keiichi Matsuda. Available at: http://www.keiichimatsuda.com/augmentedcity.php

on a physical scenario (pervasive games) such as the case of *geocatching*, necessarily cause a *re-mediation* of the physical location (Bolter and Grusin 2000) similar to that occurring at the augmented city landscapes.

The video game industry has improved, as no other agent, the user capacity to move across digital scenarios. Cyberspace has undertaken multiple configurations, from the text-only proposals of the 1970s (*Dungeons and Dragons* 1974) to the latest video games that articulate the playground out off the screen. The very rupture of the *fourth wall* (2006) brought about by the release of *Wii Sports* and its remote control by Nintendo, meant the end of a period in which cyberspace lived exclusively inside the screen (Fig. 5). Thereafter, the doors to hybrid or symbiotic realities, such as the augmented environments, were to be opened.

3 Motion Capacity in Video Games

Video games are also associated with the *gameplay* parameter. *Gameplay* 'refers to accessibility and ability to enjoy a game under its graphics, fluidity of motion, or interaction of different characters. It can also be understood as a sum of 'play' and 'skills' or 'ability to be played' (Montagnana 2008). Having said that, the interface design should allow for the best *gameplay* performance. The graphics and symbolic conditions of the space where the action takes place must also assume this 'playable' attribute. Let's the reader remember so many claims that, about this aspect of the internal spatial organization, have built the argument of all that faction of architects who have preferred the building contents to their continents, subordinating the latter to the topological development of the first and its effects on the consumer of architecture.

Despite using resources such as abstraction and other audiovisual techniques, the ultimate goal of the video game is not even the *representation* of a physical location. The evolution of technology has led researchers and video game

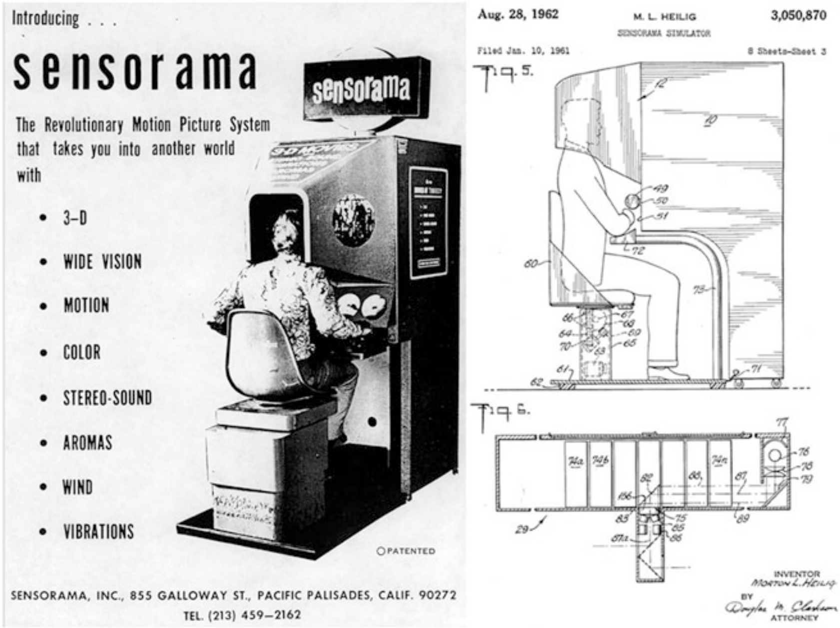

Fig. 5 *Sensorama Simulator Patent*. 1962. Morton L. Heiling. Available at: http://www.mortonheilig.com/SensoramaPatent.pdf

developers to a more complex purpose: simulation. In the field of communication, Shannon (1975) defined it as 'the process of designing a model of a real system and conducting experiments with this model for both understanding the behaviour of the system and evaluating various strategies (within the limits imposed by a criterion or set of criteria) for the operation of the system'. In the extrapolation of the system from a 'real' model to a designed model, the self-referential capacity of any system is the main supporter of the scientific method. In the simulation, time is reversible and manipulable.

The physical link between space and time qualifies and measures any kind of motion. Therefore, the interactivity of gaming scenarios can be analysed in this way right from its ability for simulated representation, or from the quality and quantity of operative motion (Fig. 6). The latter option is especially focused on the architectural research addressed. Additional variables such as weather, climate, the user, … etc. have being added to the three extended dimensions of the video game. With the help of Internet, the space that told a story has become a complex space altered by the actions of other players. As it concerns to the *augmented city*, this topological analysis of video games would trend to reflect on the concept of augmented citizen *bilocation* (remember Heisenberg's *Uncertainty Principle* and other fundamentals of Planck's quantum physics). Although beyond the scope of this

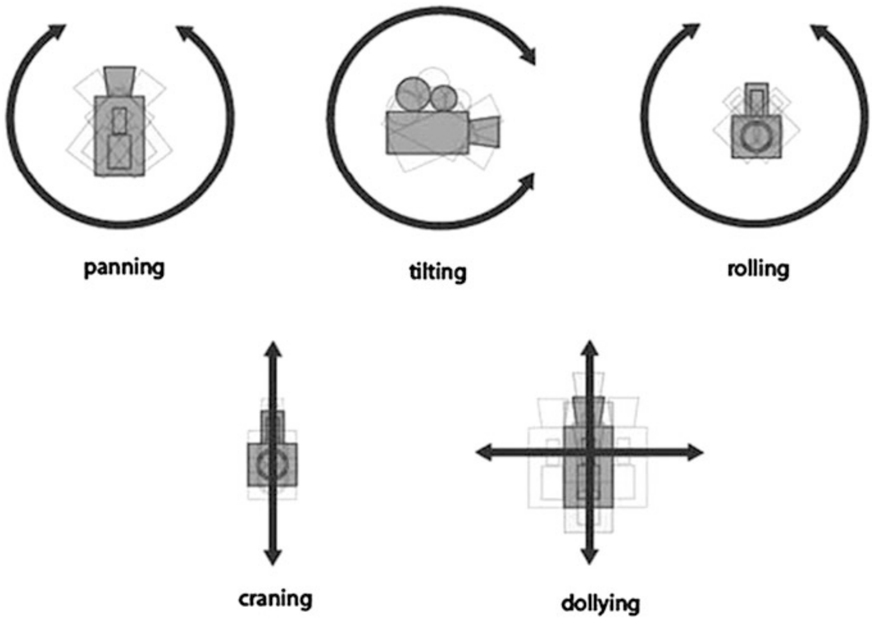

Fig. 6 *Types of possible camera movements*, 2008. Michael Nitsche

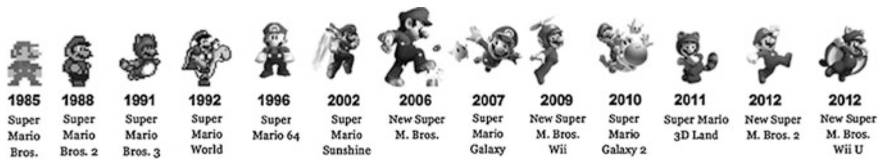

Fig. 7 *Evolution of Mario Imgur, principal* character of *Super Mario Bros*, by Shigeru Miyamoto (Nintendo 1985). Available at: http://wordofgame.com/evolution-of-mario-imgur.html

research this fact is a keyword to understand the ontological and anthropological concern of the *augmented city* (Fig. 7).

4 The Dimensional Conquer: From Eliza to Kinect, Throughout Mario Bross

The evolution of the computer game is related to the achievement of higher levels of interaction between the player and the digital scenario, a circumstance linked to the capacity for spatial simulation of the latter. Hereafter an atlas of the mentioned dimensional development is described (Fig. 8), rather topological than

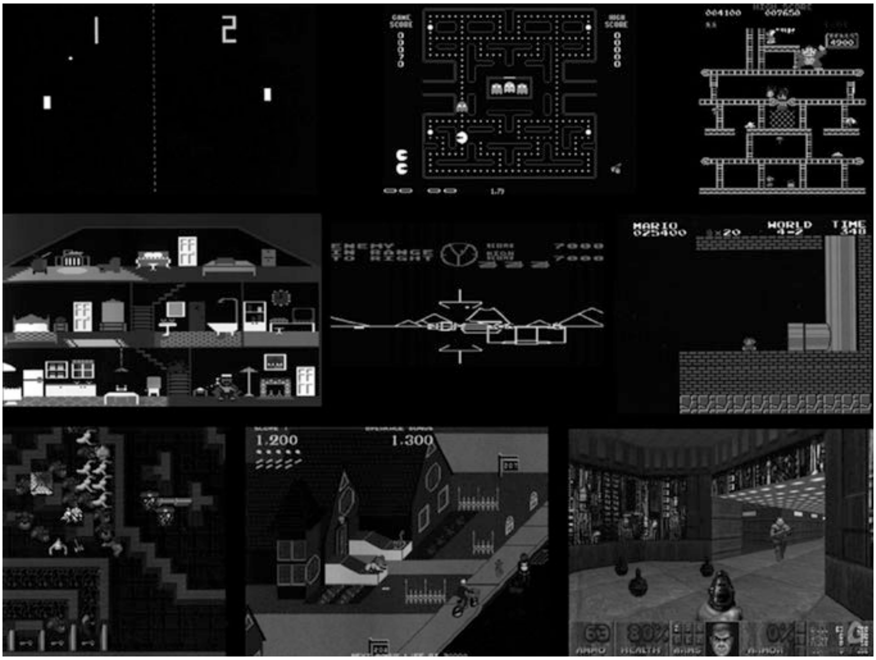

Fig. 8 *Video Games Collage,* E. Roig. From *top* to *down* and *left* to *right*: *Pong* (Atari 1972); *Pac Man* (Namco 1980); *Donkey Kong* (Nintendo 1981); *Little Computer People* (Activision 1985); *Battlezone* (Atari 1980); *Super Mario Bros* (Nintendo 1985); *Ghost'n Goblings* (Capcon 1985); *Paperboy* (Atari 1984); *Doom* (ID Software 1993)

chronological. Over the 'short history of digital *gamespace*' (Boron 2006: 26) an analogy between what happened at this realm and what happened at the proper of building architecture, adding some references of this gravitational history.

Text-based space. In 1966, MIT computer science professor Joseph Weizenbaum created *ELIZA*, a program of linguistic processing that allowed a conversation with the computer. After *ELIZA* other conversational adventure video games or 'point and click' format emerged. There, the user navigated through imaginary maps, as in the case of *The Oregon train* (MECC 1974) or *Don Quijote* (Dinamic Software 1987). These video games keep relation with Steve Jackson and Ian Livingstone 'choose your own adventure gamebooks', but also with those communication matters of Claude-Nicolas Ledoux 'speaking architecture' that is able to explain its own function or identity. The relationship between language and architecture or language and city ranked prolific episodes in the twentieth century postmodernism.

2D Space. This gamespace of a fi framing do not allow any concatenation of screens, nor any motion or action that would go out of the static framing. First 2D graphics used pixels to simulate objects. The symbolism and the metaphor related the game to the real world (*Ibid*. 26): 'friend', 'danger', 'fire' etc. *Pong* (Atari 1972) or *Space Invaders* (Taito 1978) articulated a mobility that did not exceed the limits of the screen, the game cartography came to be a sequence of screens with no other connection except the script. The abstraction of the concepts forced by technical precariousness of that time assembled a pioneering aesthetic, *vintage* today. Those *pixelations* pattern today's architectural geometries such as the one that structures the *Desert Plaza* of Barakaldo, designed by architect Eduardo Arroyo. What about the use of metaphor in the proposals of Robert Venturi and Denise Scott Brown as in many others that understand architecture alike language.

The *wraparound space* or space 'self-rolled' introduced immediately elements that produced the sense of continuity a long 2D screens. Its graphical interface allowed to make objects disappear off the edge of the screen only to reappear directly opposite to where they had vanished (*Ibid.* 26), giving the impression that the game was continuous. This endorsed the player subconscious to extrapolate and travel through a non-existent space. It is the case of *Asteroids* (Atari 1979) or *Pac Man* (Namco 1980). A similar mechanism was applied within the insertion of a semi-circular passageway or *ambulatory* surrounding the choir of Romanesque pilgrimage churches, avoiding the chaotic back- and-forth movement of the pilgrims. The conquest of architectural space continuity allows for a diverse catalogue for this topological design strategies.

The simulation of stacked platforms, like in *Donkey Kong* (Nintendo 1981), systematized space graphics by projecting the slabs where the game characters leant on. The connection between them was solved by simply stairs, the invariant architecture element whose spatial implication would be revised in the early twentieth century via *raumplan* theses by the Adolf Loos *raumplan* or Le Corbusier's *architectural promenade*.

The evolution of 2D graphics towards other proposals that would incorporate the perspective space within a 'liveable' depth included 3D simulations by using scenarios that suggested three-dimensional representations (*trompe l'oeil*). Therefore, *Q*Bert* (Atari 1982) was played in a cubic modules pyramid and *Little Computer People* (Activision 1985) was similarly played in perspective sections. The central viewpoint perspective recreation was widely applied in video games such as *Battlezone* (Atari 1980). The conquest of cyberspace *continuum* had its turning point at the space that scroll along a vertical or horizontal axis (*Ibid.* 27), which seemed to allow continuous motion where the player could move uninterruptedly through concatenated screens. The perspective was focused on the character. The *horizontal scroll* was very common in 70s and 80s arcade games, where the central character should achieve to move forward from left to right over the required events. Together with *Kung-Fu Master* (Irem and Nintendo 1984) and *Ghost'n Goblins* (Capcon 1985), one of the leaders of the *horizontal scroll* was *Super Mario Bros* (Nintendo 1985) by japanese Shigeru Miyamoto. The *vertical scroll* was less common but there were well-known examples as *1942* (Capcon 1984) or *Commando* (Capcon 1985).

The simultaneous movement in the x- and y-axis at a single 2D plane was the consequence of the combination of both vertical and horizontal scroll. Some pictorial technics were added to this moment, like the use of shadows to produce depth perception. *Gauntlet* (Atari 1985) and *Sim City by* Will Wright (Atari 1989) achieved it by using the colour and the chromatic contrast—remember the reader the importance of colour on the perception of the Greeks temples. The aerial view was usually the one chosen for it. In elevation, the *multilayer* space organized an action that happened in a simulated isometric view by using a dense and deep background. In the case of *Shinobi III* (Sega 1993) it was achieved by the gradation of the background layers movement. This overlaping of figures in different surfaces was also a common strategy in pre-Renaissance pre-perspective painting, for example, in the intelligent work of italian artist Paolo Uccello.

3D Space. The achieving of digital movement around three axes marked an analogous breakthrough with the use of three-dimensional depth module by the Filippo Brunelleschi's *Hospital of the Innocents*. If *Paperboy* (Atari 1984) was close to this graphical solution, *Doom* (ID Software 1993) was to put into practice the so-called '2.5 D', where the motion in x-axis was not contemplated but the level of soil varied in height and the characters were shown from top to bottom, although the weapon aim in the foreground plane kept strictly horizontal. If *Wolfenstein 3D* was the forerunner of this genre, *Doom* laid the foundations for a new stage in the kinetic typological conquest of digital place. The witness of *Doom* was taken by *Quake* (ID Software 1996), the video game which achieved full 3D space. This progress is analogous to that got by Van Berkel and Rem Koolhaas's folded architectures. *Yokohama International Port Terminal* (FOA 1995) is also a clear and paradigmatic example of this space archetype.

Augmented space. As stated above, *Wii Sports* (Nintendo 2006) created the first augmented scenario. The next step was to get a *headless augmented space* where the player operated the interface through body gestures, without carrying any electronic device on—without brush, like in automatic Jackson Pollock painting. This was the pioneer case of *Dancing Stage*, also known as *Dance Revolution*, or *DDR*, precursor of Kinect console. *DDR* was to move one's feet to a set pattern using one or two dance pads. Since then, many video game scenarios digitally parasite real physical scenarios. The interface is operated by body gesture—e.g. eye tracking interaction—without activating any buttons, similar to that the citizen actives at the ubiquitous computing in the *Smart City*.

5 Conclusions

In view of analogies raised throughout the text between the architectural discipline and that which deals with designing and developing video games, clear similarities in related areas of knowledge are observed. The opportunity to understand the architecture as a quality that subverts gravity, referring to a more complex categorical order, unlocks the disconnection manifests between respective disciplines. From this consideration, the physical place and cyberspace, both in academia and in professional realm, are running for being part of the architectonic in its broadest sense.

The employment of architects by video game companies is well known. There have been reported some possible projections of architect polytechnic profile in the field of video game design. This digital format of enormous diversity and not always leisure-related *requires* architects with gamer ascending. Today interdisciplinary transfer is taking place outside the academy, where self-taught vocations design through 'craft' procedures the link that makes possible the connexion between both disciplines. The convergence of knowledge—if not overlapping-invites to think on the insertion of a video game subject in the architecture bachelor curriculum or even on the possibility of a double degree, with tremendous synergies that this program could raise.

But the truly reason why this academic hybridization is proposed is not even the one just outlined above. There is another essential reason that regards to the construction of the city of our common (technologically) *mediate* future; a city whose immediacy is not necessary to be reiterated. Its design cannot be afforded without regarding its dual physical-digital condition. In order to this consideration, the validity of a generalist profile is unquestionable, both trained in humanities and technologies, that participates in this type of urban planning along with other urban and ICT experts. This professional necessity charged by the technological imperative can become optional under the breath of a curriculum that provides knowledge and skills related to this dual condition. The involvement of the architect in the design of the augmented city implies broadening their knowledge with pedagogies that project cyberspace, and by extension, pedagogies applied to the teaching of the architectural foundations of gaming.

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Playful in Creative Phase

Jessica López and Mónica Gómez

Abstract The following article "*Playful in the Creative Phase*" approaches the issue of creativity and how it can motivate you through games in order to explore and find different solutions; because while more ideas appear in our consciousness there are greater opportunities to project, starting from the premise that when we are young we have fun, we explore and enjoy new experiences.

Keywords Creativity · Motivate · Build

1 Approaching Creativity

The theme of creativity has been studied from many different perspectives. According to the Real Academia Española, it is defined as the "power to create" or "capacity of creation", i.e. to produce something from nothing, setting up something for the first time. In the field of design, the concept of creativity could mean *inspiration, give an answer to the problem, or to be enterprising*.

De Bono mentions that creativity is mysterious, because we see that it produces new ideas but do not know exactly from where they came (De Bono 1999, p 28). But creativity is not like magic, even if you think it is by its manifestation; however it requires dreams, goals, work, concentration, trials and errors, attempts, frustration and motivation.

The first studies about creativity were made by Galton, who addressed the topic about men endowed with genius. At this point in history, the hereditary conception of creativity arises since they are equipped with indefinable qualities that allow them to achieve great things (Galton 1999).

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However, in the early twentieth century, other re- searchers such as Ribot, observed that creativity is not exclusive to geniuses or prodigies as mentioned by Galton but is present in all human beings, although the intensity and implementation differs (Ribot 1901).

Gliford subsequently provides the basis of a growing interest in creativity, which makes different theoretical explanations of the origin and development of creativity and how it can be stimulated. Some features that he identifies are: fluidity, sensitivity to problems, originality, and flexibility, development of ideas, ability to redefine and insight into the problems (Gliford 1950, 444–454).

According to these characteristics it is important to create environments which cultivate interest and curiosity. It is therefore important each day to find the surprises, the desire to explore and browse either by what you see, hear or read. The rebirth of curiosity does not last long, but when it wakes this creative energy is necessary to protect and motivate, what really matters is to escape routine and experiment.

2 Motivation in Creativity

Bachrach (2012) mentioned that motivation is a key factor of knowledge; nobody learns anything that does not interest them nor can they generate creative ideas if they do not make the problem their own. Creativity is difficult to cultivate on its own; the important thing is to stimulate it because the brain has the ability to keep learning and changing until the last moment of its life. All from birth have the opportunity to be creative, and if we use the techniques and methods, we can strengthen and stimulate creativity to generate new ideas.

When stimulating it takes effort and energy on the part of our brain to find different possibilities and answers to a problem; that is, an idea is generated. This is supported by a growing body of evidence that allows making decisions and problem solving, generating learning.

Some factors proposed by Flores favoring creativity are: *Environment, personality and specific techniques* (Flores 2004). In general terms creativity seeks to improve the quality of life and make it more productive, responding to all kinds of problems and providing satisfaction through innovation, consistency and perseverance.

In general, human beings are potentially creative for their intelligence, regardless of their social status, age or place of origin. So keep in mind that the human being at birth has a *potentially creative personality*.

3 The Personality of Creative People

Having explained the usefulness of creativity and how it can be motivated, it is important to know how humans can develop a creative personality. However, at birth a person may have some biases in his or her environment, which directly influence the development of their personality. Csikszentmihalyi describes some characteristics of creative people and their ability to adapt: That is, how man copes with what is around him in order to achieve his goals (Csikszentmihalyi 1998).

Some of these features include: A large amount of physical energy, very lively with playfulness and discipline, rebellious and independent, very passionate in work and a closeness to pain and pleasure. This is complemented by what Fregoso says—he mentions the attitude of play in their surroundings and life, the joy of life with a positive attitude, desire and enthusiasm being a mixture of hope and will, love and forgiveness—they are inquisitive and persevering (Fregoso 2007).

The above features are reinforced by what Howard Gardner mentions in his book "Creative Minds", which mentions that most of the major creative figures in history lived in unfavorable locations. Their biological families were not wealthy, so they had to devise a way to have a comfortable life. In their childhood their educators valued their intellectual learning and achievements. As they matured their creative output was reduced, but their capacity for criticism increased (Gardner 2011).

Upon reflection when a person is an adult, the body of knowledge and experiences that were acquired throughout his life allows him to discern and analyze information. This in turn at some point could prevent him taking risks in exploration. It is therefore important to have a reason to motivate, stimulate and cultivate creativity, so that when something blows up a spark of interest, they pay attention (Fig. 1).

Fig. 1 Students in the class of architectural expression drawing Huentitán Canyon. Image captured on February 2014

An example would be the recreational activity that can stimulate the brain in finding solutions and as well as finding the fun, to express and substantiate according to beliefs and experiences, and to question the wisdom of past centuries in order to try and find something new, being able to overcome obstacles, seeing it as a form of growth, balancing and integrating art, science, logic and fantasy. That's what some call wit: *the ability to see opportunities where others do not see.*

4 Playful and Creative Trigger

This period corresponds to a part of the workshop of creative triggers, which since 2012 a team of professors from our university have been teaching in various National Universities to students of the Bachelor of Architecture and Interior Design and Atmosphere. The workshop was conceived with the initial idea that students know various creative techniques that assist them in defining their projects.

How to work in these workshops is based on the modus operandi of Leonardo Da Vinci, *Father of Creativity*, used to understand the basics of nature and how its mechanisms work. Let us remember his large graphic production, achieved thanks to his curious attitude and wit.

Then we transferred the experience of Leonardo to the creative workshops we offered, including as creative triggers other contemporary elements*: works of art, technology products, games of blocks, collages, foils and visualization through images and concepts*.

The implemented methodology is based on three fundamental steps that Leonardo Da Vinci took: *observe, transform and create*. We consider that they are a practical and easy way for students to remember in areas of design. So then the workshops we have been providing have as their main objective the student remembering and applying the steps in subsequent processes of conceptualization.

These triggers are not unique to architecture, they can be and have been applied by other design professionals; because what we all have in common is that our projects are the product of a creative process. Our specific academic field is applied in the teaching of architecture and interior design and atmosphere, so we can elaborate on this experience.

The theme of creativity is broad, but the intent of this article is to share the experience in implementing one creative technique such as the game of blocks, leaving for later writing to share the experience in the application of other techniques.

The word *lúdica* or playful, according to the Real Academia Española, is "the action and effect of doing something with joy in order to entertain or have fun." This action is not peculiar to childhood but is constitutive of man.

Branda explains that *the dream, the game and the creativity* are part of the natural expression of man and constitute part of education, culture and communication. The formative role of play and creativity in human life, and particularly in children, is crucial for the future of the individual (Branda 2005).

The ability to create and learn is closely related to the ability to play. To create something that does not exist is not enough, it is important to assign a value to the new result so it can be "useful" and lead to a "change". Albert Einstein mentioned that "the game is the highest form of research" and that "insanity is doing the same thing over and over and expecting different results" (Sanz).

In the field of design of generating a new project it is necessary to start from a concept, idea, mental representation or object. So an example is shown of how a creative exercise based on the *game of blocks* with university students in the Bachelor of Architecture and Interior Design is developed.

5 Playful Exercise to Design

As Woolfolk (2010) says, creativity can be enhanced through learning strategies. One is the *game of blocks*. This promotes learning and is linked with motor skills and conceptual logical development.

It allows you to explore and develop eye-to-hand perception, fine pressure, coordination of actions, quality of movement, structure relations involving equilibrium, stability and balance, analyzation of shape, texture, color and thickness, relation of objects, and the design, planning and solving of problems.

This type of learning strategy can be combined with the creative process proposed by Graham Wallas in 1926 in his book "The Art of Thinking," which includes four phases: *Preparation, Incubation, Illumination, Verification*, and adding one more: *Elaboration* (Wallas 2014). What, in his time, Leonardo Da Vinci solved with three steps: *Observe*, *Transform* and *Create*. For purposes of explaining this exercise we will build on the steps proposed by Wallas (Figs. 2 and 3).

Fig. 2 Material to work on the exercise of blocks as an element to generate creativity. Image captured on September 10, 2015

Fig. 3 Students of the subject of architectural expression, building design elements with blocks. Photography captured on September 10, 2015

6 Phase One: Preparatory

Teaching material blocks are distributed to work individually or in groups, and these individuals or groups are told that it is time to play and remember what they did when they were young. A dynamic is performed asking with what other materials have they played. Some respond that they built cities, houses, furniture, aircraft, and automobiles; using different materials like dominoes, playing cards, cushions, clay, mud, sheets and blankets, wooden sticks, among others. With this exercise begins the awakening of their inner child (Fig. 4).

In this phase there is a high degree of excitement thanks to the playful attitude which allows them to experiment and try different possibilities, giving them the freedom to build and imagine anything. To do this, they arrange blocks overlapping one over another in order to build something, not yet knowing what will happen or to where it will lead.

Next, questions are asked to students in order to sound out what they thought about when playing. Some shared that they represented a house, furniture, a fountain, a building, housing, a shopping center, among others; the subject of architectural design being the common denominator. Subsequently they asked the students to take pictures from different angles as shown in the following pictures, doing a 360° tour to view the object.

Subsequently, based on digital photographs, some figures of the images are traced, marking silhouettes or whatever comes to their attention of some facet of the composition. Then they make a series of geometric designs that allow identification of dominant forms, compositions, positions, to continue discovering new elements that could trigger a different project or reaffirm the original idea.

At this point some students draw directly on the screen of a tablet, others print images of interest and trace them on the basis of photographs or directly drawn upon their observation of the model. During this phase of exploration and

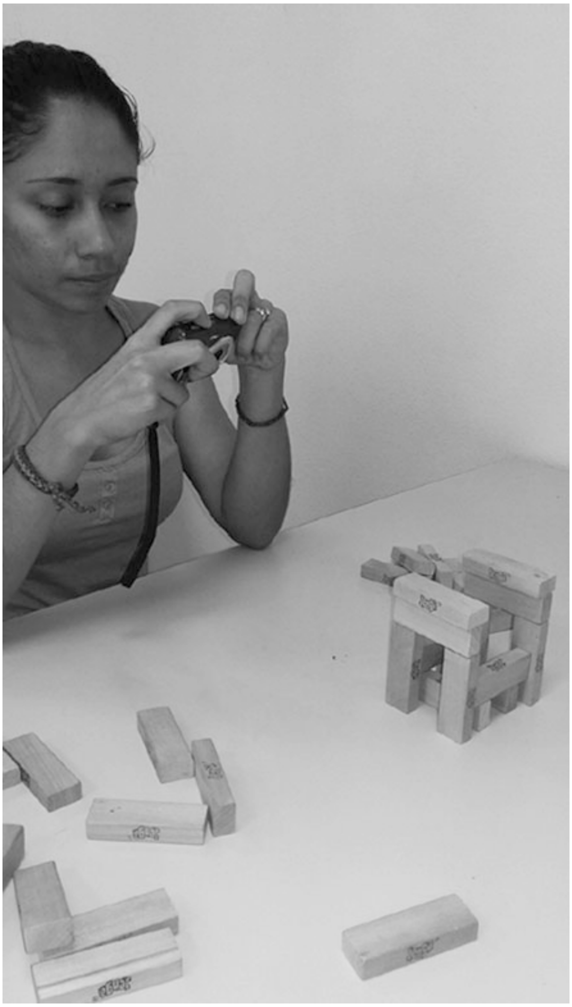

Fig. 4 Student in the class of architectural expression with taking images with 360° view on modeling with blocks. Captured on September 10, 2015

observation of the initial object the student continues to experiment; perhaps he is not yet clear of the purpose of his fi design, but through sketches new forms are permitted that at fi sight were unseen.

7 Phase Two: Incubation

It is in this trial and error phase where you set a timeout to subconsciously find alternatives. It is considered a period of emotional stress where there is doubt whether or not the objective will be achieved. To decrease tension students are recommended to modify their creative environment, in a way that is favorable to graphic production, based on the awareness of the senses: play nice music, eat or drink something that pleases them, have motivational images in sight, comfortable clothes that allow them freedom of movement, and if you want, even aromatize your space.

At this stage it is important to produce various sketches and drawings generating alternatives to later make the selection of what could subsequently trigger a more specific possible proposal.

In Fig. 5, a series of illustrations is shown as a result of the above sketching. At this stage it is important to have a large graphic production that will lead to more informed proposals.

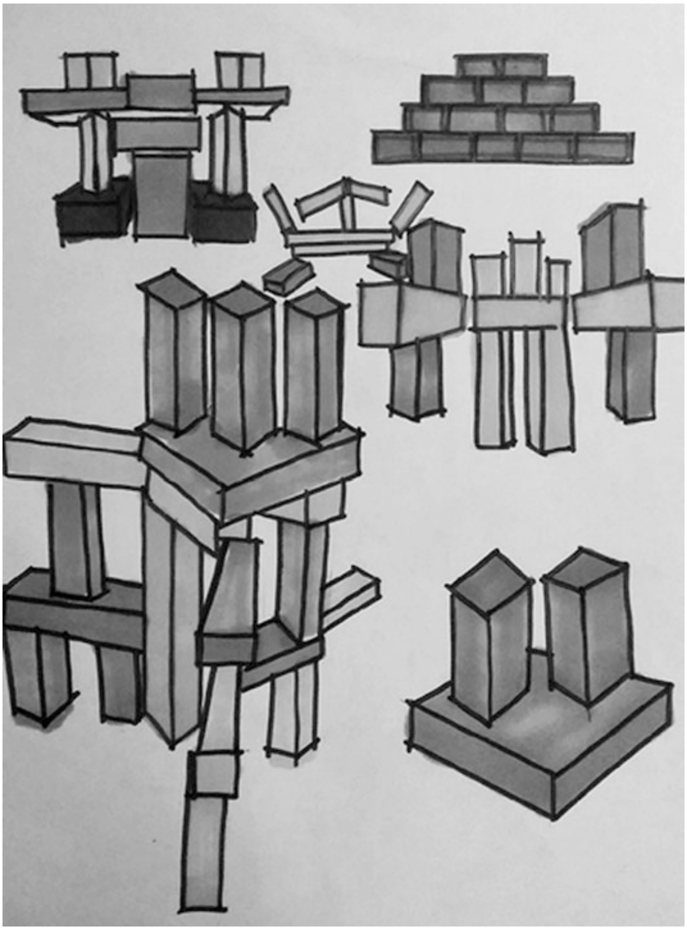

Fig. 5 Sketch with design solution to display poroyecto. Captured Sept. 15, 2015

8 Phase Three: Illumination

It is while working on the process of sketching that the solution arises; this is the time when everything makes sense, and it is possible to relate and clarify the process. More defined lines are made with figures that acquire meaning and may have a specific use; greater enthusiasm occurs, since the student begins to more clearly visualize design products, and it is then the invested effort pays off.

9 Phase Four: Verification

At this stage the selected solution is analyzed, verified and validated. It is decided if any of these revelations has some value-defined contribution and whether it can be carried out. It is an emotional moment, where you have to process the idea and try to decide whether or not it actually does. Often at this stage there is uncertainty and insecurity towards the last design decision because you are dealing with something unknown.

In this exercise you can apply different levels of applications: *furniture, architectural* and *urban*. Everything will depend on the ability of the student's visualization. The scale can be defined by adding the human figure, which gives proportion to the drawing, defining it according to the size in which it appears, whether inside the object, over the object or next to the object. As an auxiliary of the scale, you can add elements that help contextualize atmosphere in order to design and give meaning to the proposal (Figs. 6, 7, 8, 9 and 10).

Finally, students present their project, explaining each of the phases they went through up to that point. A dynamic feedback is carried out, in order that students receive their own and other's reviews.

The images correspond to the verification stage. Plotted drawings or computer models are developed, applying color, texture and atmosphere to begin to define the type of materials, possible finishes and the environment where it can be implemented, focusing on the last appearance of the proposal.

Fig. 6 Housing complex of Daniela Vera Godínez, student

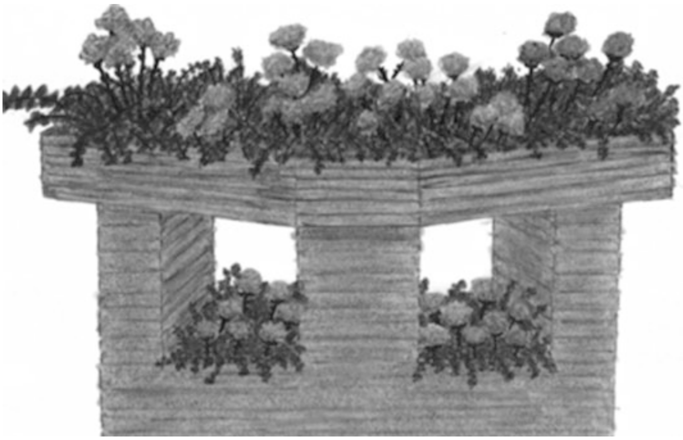

Fig. 7 Garden Designed Project of Alejandra Venegas Contreras, student

Fig. 8 Center table of Jessica Elizabeth Vázquez Canizales, student

Fig. 9 Shelf designed of Lluvia Itzel Gómez Arteaga, student

Fig. 10 Hotel project of Nayely Michell Rodríguez Alvarado, student

10 Phase Five: Elaboration

This last step is not in the scope of the workshop due to time; it involves moving into production of technical drawing and makes the project definition. Here the fundamentals of design, functionality, aesthetics, viability, meaning, linkages, and zoning generally are tuned to materialize. Therefore there may be significant changes in the design. The above process can be improved and only served as an excuse to start to trigger new ideas.

In fact Edison said "99% perspiration and 1% inspiration." In this last stage it is important to do more to implement what is necessary, struggle, change, encourage and convince others that the project is really suitable for building, since the process experienced in the previous phases is just the conceptual stage of the project, which can be the integral guiding axis of the final design.

11 Conclusions

The instructors for these workshops reflected and concluded that creative freedom was fueled by a work environment conducive to being an independent workshop of curricular school subjects; allowing students to work without pressure of getting high grades or solving a specific problem.

We believe that this experience contributed to clarify the creative process existentially, giving students an opportunity to experiment, have fun, enjoy, understand and implement solutions in a relaxed way using a creative process that allows them to face the blank page and their fears when designing any future problem. This has made it possible for them to incorporate concepts of innovation in their proposals, since the results that each student presents are always varied. We attribute this to the fact that each student makes use of his own technological resources and personal skills, also reflecting their culture, their personal history and previous knowledge.

As for the graphic innovations of these workshops, it has been possible to break the paradigm of going *from the manual to the digital* with an awareness that the way of doing things has changed. This historic moment marks an important difference in the way our youth see the reality: *now all is becoming more through new technologies.*

To achieve this it is important to be open to new ways of seeing, doing, thinking and designing. The main challenge is to create meaningful connections in our brain through different inspirations, perspectives and ideas in order to develop a creative voice, but also being able to obtain an education.

Therefore, it is concluded that working with this type of creative techniques, as is "*The game of blocks as creative trigger*" may motivate college students because it allows them to trigger creative and fun ideas, developing motor control and conceptual logic by *observation*, *perception* and *drawing*.

It is important to note that there is no formula as such to be used throughout the world in the development of creative process. But it is adaptable and fl because it can respond to different factors, resources, experiences and tastes, and fi products vary from designer to designer and from beginning to end, since each is an evolutionary process that seeks to reach a solution.

In teaching we believe as university professors we have a high degree of responsibility, because we are training the professionals of the future. We must therefore seek to develop in students a more open panorama that allows development of the creative capacity to deal with ease and confidence in themselves, as well as being innovative and proficient in their design projects, remembering that the characteristic peculiarity of creative work is that it had never been done before.

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Multi-sensory Experience in the Creative Design of the Project: How to Materialize Them in Spatial Language

Amélia Panet Barros and Isabel Medero Rocha

Abstract The perception of architecture is a multi-sensory experience and not only occurs with the eyes. At present, exacerbation of media images makes architecture increasingly designed and perceived prioritizing the sense of sight over the other senses. Although the multi-sensory experiences are important to grasp the nature of architectural space, in the architectural education, this knowledge is usually limited to activities in form studies courses, aesthetic or experimental workshops, examples that unfold to the world of architectural and urban design are rare. This paper seeks to highlight the importance of these multisensory experiences in teaching. It presents some possibilities for materialization of sensations in a spatial language, as a creative way in the conception of the architectural and urban project.

Keywords Creative design · Multisensorial experience · Spatial language

1 Introduction

Representation has meanings that go beyond the object represented, it refl how we perceive and conceive the world. The perception of what surrounds us is the fi result of our philosophical, technical and artistic knowledge, linked to an idea of society, culture, beliefs and traditions. It is the result of the worldview, or of what one selects as essential for the representation of that world. As we follow the history of art over the centuries, and the use of perspective techniques used to convey three dimensions to a fl representation, we will perceive their specific related to peoples, time and space. Epistemological questions imbued with meanings that go beyond

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the object and the mechanics of what is seen and what is represented, transcend to issues relating to the act of perceiving, the sense of being and the sensations caused by multi-sensory experiences.

As well as we perceive the world, the perception of architecture does not occur with the eyes only. In Heidegger's phenomenological approach (1954), Bachelard (1993), Merleau-Ponty (1999) and Norberg-Schulz (1976), his understanding is a multisensory experience. Pallasmaa since 1999, warns us, in essays and lectures, to the worrying fact of how architecture is still conceived and perceived giving predilection in favor of vision and to the detriment of other senses (Pallasmaa 2011). Although the author does not refer to images mediated by digital technology, the ease of access ultimately contribute to the proliferation of architectures not yet completed, spreading unfinished design solutions concerning aspects that should explicitly give them sense, while considered architecture, such as those tectonic and socio-spatial. In this haste to the image, architecture is represented before it is even conceived.

This is one of the major challenges faced in teaching architecture design. Information overload, when barely ended, contributes to a superficial and fragmented worldview, where the architectural quality is lost in face of solutions of figurative appeal. In this imagistic universe, many times, architecture arises with a project as a result of a programmatic listing of functions, emptied of sense, relegated to object.

From the 1990s, the idea of corporeality in architecture started to be revisited by sectors of architectural critique, bringing the concept of event as a transforming element of the architectural space, thus, overcoming functionality concepts and prioritizing the interaction between man and the space, the activities and the use. Following this path, some research initiatives and experiences in design studios look to stabilize the divergence between the individual and the architectural object, advocating the participation and autonomy of the user in the production, appropriation and experience of the architectural space.

In this article, we present two design studio experiments, which seek to enable the insertion of the being since the conception. The first one seeks to stimulate the representation in spatial language, of sensations that can collaborate with the architectural design conception. The second one explores intuitive features looking to subvert the conventional order: design, construction and use for construction, use and design and investigates the sensory capabilities of the act of perceiving as a guidance for the design genesis. Both experiments value the sensitization as a path to architectural design conception.

2 The Meaning of 'Senses' in Architecture

According to Nesbitt (2006, 31), the unconscious relation of the human body and architecture has once again become an object of study in the postmodern period through phenomenology. The architectural theory tried to approach the "philosophical reflection by discussing the interaction of the human body with its environment." In the 50s, through Heidegger (1954) and Bachelard (1957), "the phenomenological reflection on architecture began to take the place of formalism []." For the author, the phenomenological paradigm seeks to highlight a fundamental issue of aesthetics: "the effect a work of architecture produces in the observer" (Nesbitt 2006, 32). In that approach, issues related to aesthetics and creativity, such as issues of perception, meaning and significance, whose sense of experience seems to be impenetrable to the scientific method, are appreciated philosophically, thus allowing an approximate knowledge. Allied to cognitive research, major advances have occurred in understanding the design conception in both its objective and subjective spheres.

As registered by Bachelard ([1957] 1993, 237): "Philosophy puts us in the face of very intensively coordinate ideas, so that, detail by detail, we place ourselves and come back to placing us at a starting point situation, as should a phenomenologist do." We believe that this cyclical movement of knowledge allows the story to be combined in the formation process, not only the history told, but the possibility to revisit it through sensory experiments that collaborate in building memories. The sequence of ideas allows us new-old experiences that are perceived in various contexts seeking new directions.

Bachelard ([1957] 1993, 239) invites us "to look with new eyes." This stimulus seems to be essential in the creative process of the architectural conception. The "look with a new gaze" does not discredit what was already seen, it does not ignore it, nonetheless, it brings it to an existence condition of primary source, while releases it from perpetuation and from the permanence of this one habit, which presents itself in repeated actions that often have lost their own reason for existence. Such experience with a new regard will awaken new senses in multisensory experience, where this regard is not only perceived with the eyes, but as in Pallasmaa (2011), with the eyes of the skin. To Pallasmaa (2011, 11) "the ultimate meaning of any building goes beyond the architecture; he directs our awareness to the world and our own feeling of having an identity and being alive." For the author, "a work of architecture (…) offers pleasant formats and surfaces designed for eye touch and the other senses but also incorporates and integrates physical and mental structures, bringing greater coherence and meaning to our existential experience" (Pallasmaa 2011, 11).

Nesbitt (2006, 32) reinforces this sensory aspect of the spatial experience when he emphasizes that the phenomenological approach to architecture valued the process of doing; raising not only the material issue of architecture and its physical elements or boundaries, but also "invigorated the interest for the materials' sensory qualities, light, color, and the symbolic and tactile significance of the joint." This set of values seeks to enhance the essence of the place and the sensations one can experience in it. In this approach, follows the report of academic experiences that seek to exploit the various human senses in architectural apprehension and conception.

3 Experience Report—Representing Sensations in Spatial Language

Experience 01—Memorial to Families and Victims of Military Dictatorship

This work proposal was performed during the course Graphical Representation Design that aims to work the various methods of representation and expression as the language used in the conception of an architectural project. It was proposed to have a Memorial to the Families and Victims of the Military Dictatorship of the state as an object of study. Various activities were proposed with specific purposes. Students were encouraged to learn about the history of these families and their victims; and revisit the feelings involved at the time through videos, texts, testimonies, iconographic research, among others. Next, some activities reinforced the design process, since the development of the spatial concept of the proposal until its development in primary level of study.

First stage—The spatial language of sensations experienced with the senses. For this academic experience, the process was essential in the acquisition of knowledge and in maturing the design solution through research of topological, sensory and spatial relations. The first architectural design exercise aimed at working out the translation of some sensations in spatial language. For this exercise, we took the opposite sensations of fluidity and density. The raised question was: How to translate fluidity into spatial language? Also, how to translate density into spatial language? By using analogical reasoning students investigated the relation of images and spatial solutions that could give the characteristic of spatial fluidity to a room, as well as its opposite, the characteristic of spatial density. The practice stimulated the search of a thesaurus of each word/sensation, to find similar meanings in the spatial context (Fig. 1).

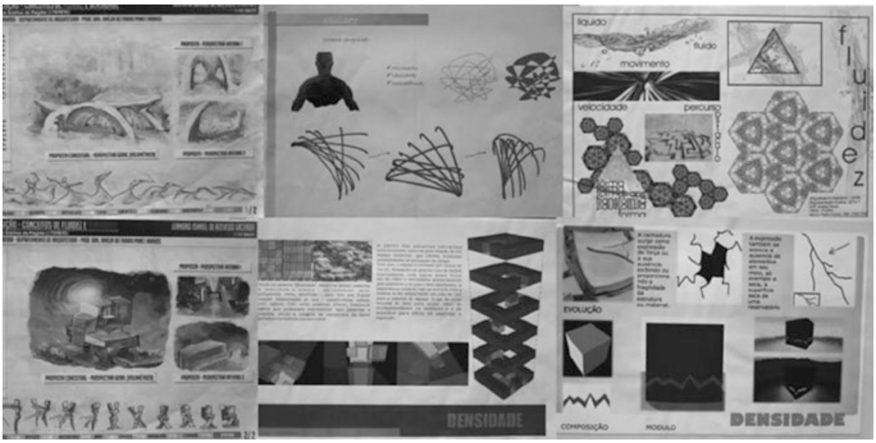

Fig. 1 Diverse materialization studies in spatial language, of fluidity and density. *Source* Authors' collection (2014)

Second stage—Historical approach and multisensory experiences. At this stage, the history of the Brazilian dictatorship was experienced through photographs, visual arts of that time and testimonials from members of the state's Justice Committee. The students encountered real stories, familiar faces, forms of torture, closure procedures and violence in many different ways involving the victims and families of the military dictatorship in Brazil, and, specifically in our state. Emotional involvement was necessary so that such emotions could be powered for the architectural design conception process. A new thesaurus of words related to the events served as a reflection for possible concepts and spatial sensations made possible by their proposals. Thus, feelings of loneliness, collapse, death, confinement, darkness, pain, interruption, absence, metamorphosis, among others, joined the other positive feelings as freedom, continuity, life, hope, future and democracy. This stage was concluded with the analysis of related projects of memorials to the dictatorship or the like, where the spatial concept could be present in the work and discourse of the authors.

Third stage—Diagrammatic studies. The third stage began with identifying the context for the proposal implantation: a property located in a significant part of the city. Field visits for acknowledgement and diagnosis of significant project constraint for the preliminary study (usage and occupation, reference, access, circulation, living spaces, solar orientation and prevailing winds, legislation, vegetation, among others). At this stage, the use of diagrams was essential. An expository lecture oriented and differentiated the types, uses and functions of the diagrams in diagrammatic thinking as a tool for architectural design research. The diagrams were used to define the spatial concept of the proposal, to represent the urban context and to explore the architectural idea. In education, the use of diagrams has a great advantage that is not inducing the student to use certain language or a range of predetermined shapes. It explores the ideas and their relation. It stimulates questioning, speculation, experimentation, delaying a formal proposal and allowing the speculation of new spatial relations. Filipe Gonzales' diagrammatic studies demonstrate the desire of coordination between the three levels proposed for his project (Fig. 2).

A central space begins to take a circular configuration that serves as a link between the paths to be experienced by the users, according to the author, through sensory experiences that are able to remit them to sensations experienced by the victims of the military dictatorship. Then diagrams progress to overlapping spiral fluid spaces allowing different forms and degrees of interaction between levels. Spatial continuity appears to be given in the upper path integrating the interior with the exterior. Maria Luisa Vieira explores the pathway as a strategy to experience two paths that the student named: the 'path of the oppressor' and the 'path of the oppressed' (Fig. 3).

However, such paths are not presented as dichotomies between good and evil, but represent time positioning in the historical context of Brazilian military dictatorship. The student worked three different planimetric levels, with distinct functions, according to the historical moments lived by the victims: (1) doubt; (2) closure; (3) freedom. At this stage, the spatial concepts of the proposals were

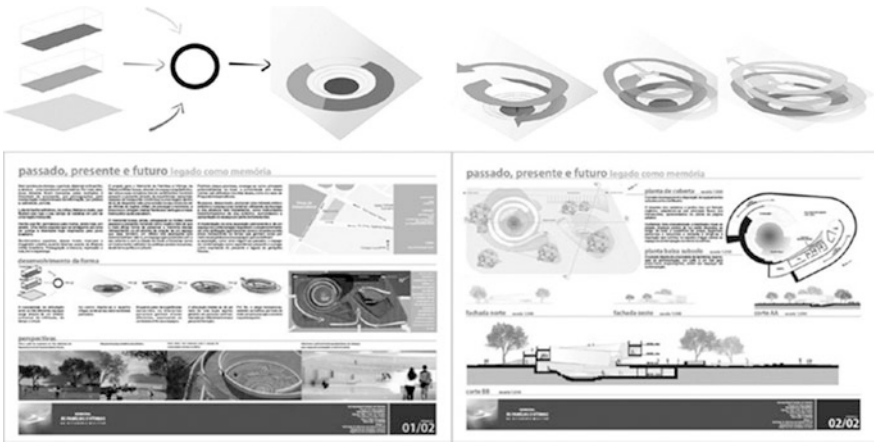

Fig. 2 Diagrammatic studies and project by Felipe Gonzalez. *Source* Authors' collection (2014)

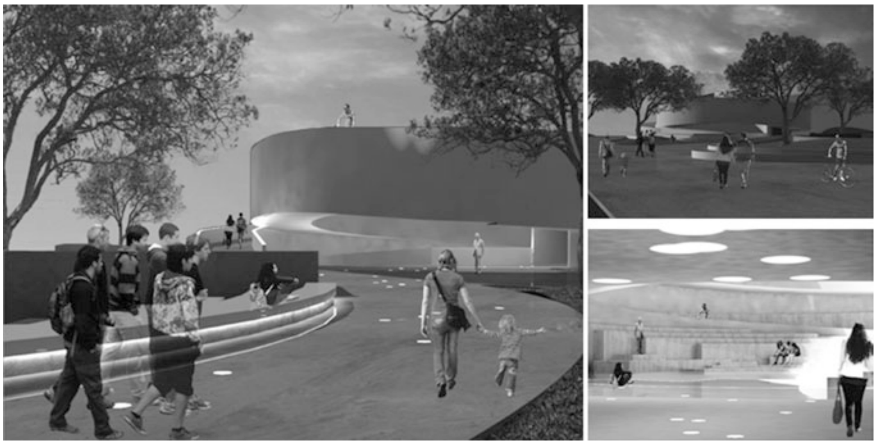

Fig. 3 Images from Filipe Gonzales' project. *Source* Authors' collection (2014)

determined, followed by the definition of project's guidelines that should specify 'how' these concepts would be worked spatially to give character to the proposal. As an example, in the 'spatial fluidity' concept, the student should define in their design specification guidelines, 'the how' fluidity would be shaped in his space through ongoing plans, by means of hollow elements, through generous openings, and others. Such concepts debate in the study program and spatial organization of the whole. The methodological aim of the experiment was to enable a design process that could take into account the multi-sensory experience of architecture as a spatial phenomenon (Fig. 4).

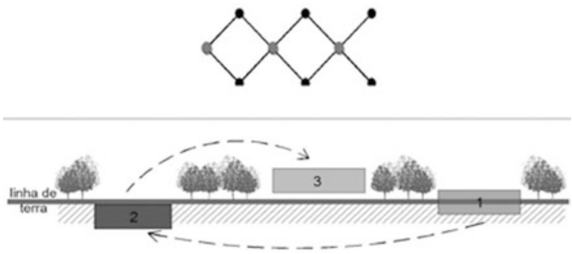

Fig. 4 Diagrammatic study of Maria Luisa Vieira's project. *Source* Authors' collection (2014)

Fourth stage—Finalization and systematization of the project process. The final stage was represented by the development of the architectural design and its textual and graphical record. Its presentation was synthesized in panels registering the entire design process. The exercise of synthesis in panels brought about other reflections on the figurative and textual choices to express the process. The oral presentation completed the process contributing for the understanding of the design conception (Fig. 5).

Experience 02—the experiment as an interface between the senses and the concept of architecture

The course of Plastic Atelier II, locus of this experience, is located on the second semester of the graduation curriculum, and belongs to the axis of Design and Representation. It aims to study the plastic form of the architectural object, its relation with space and the environment, considering architecture as a space experienced in a multi-sensory way, exploring the senses in the design process and experiencing it. In order to develop theoretical and experimental knowledge in the field of perceptual and sensory categories, purposeful actions are designed to enable the experience and reflection on the phenomenological attributes of the architectural space.[1] The purpose of the preliminary experiences is to enable the seizure of sensations by the students that can collaborate for the architectural design conception of interactive spaces. The final proposal, a prototype built in real scale, should allow audience interaction and a multi-sensory experience (Fig. 6).

First stage—Intuitive Experiment: Building Habitat/shelter (individual). The experience begins with the intuitive and fast execution of an individual habitat, a small shelter, without a previous design and with material limitation. The materialization of the shelter seeks to record the momentary desire of the student and should express his spatial intention, his functional purpose and his building strategies. It is implanted in a place chosen by the student, either internal or external. The materials used are rods, cardboard, plastic fabrics, fixtures, settings, joints and alloys such as wires, strings or nails. The spatial configuration is free, as well as the techniques used for its implementation. The shelter construction process

[1]We believe that the act of perceiving, from the cognitive point of view, involves mental processes ranging from memory to sensory issues that influence the interpretation of what is perceived. The act of perceiving, besides involving the five human senses, also explores the spatial and temporal issues.

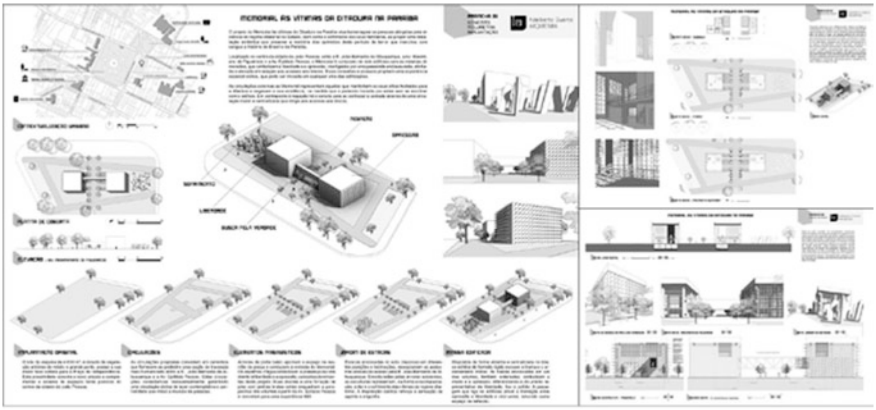

Fig. 5 Adalberto Duarte' Project. *Source* Authors' collection (2014)

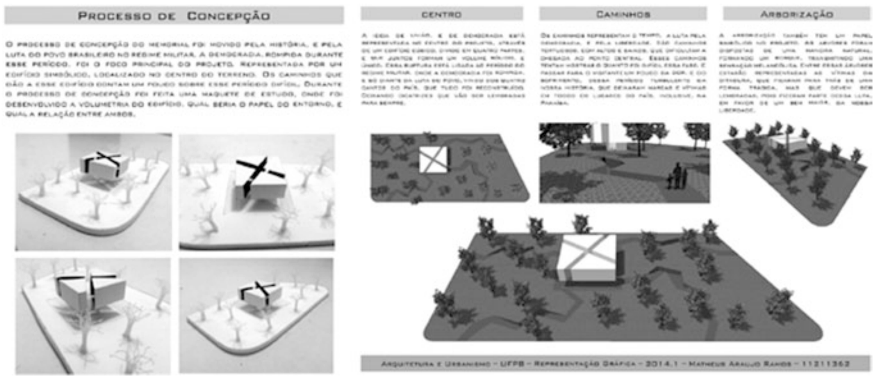

Fig. 6 Matheus Ramos' Project. *Source* Authors' collection (2014)

is interactive, the relationship with the person's own body, as a content of this shelter performs the dual function of mediating design and evaluating the success of its development.

In developing and testing the space, the student faces, in a preliminary way, some architectural typological categories, as well as some inherent constraints to the architectural design, both from the perception point of view and experience of the space, enjoyment and seizure, as structure, environmental comfort, systems and construction techniques. The whole process of construction and experience of the prototype is registered by the student, and subsequently used as a material for reflection and improvement of spatial, sensory, functional and constructive issues. Back at the studio, the students carried out an evaluation of the experience and its outcome, trying to confront intuitive solutions taken in the construction of the shelters, with some basic notions on structure, stability, proportion, scale, geometry, strengths, action and reaction. Environmental and thermal aspects are also evaluated, as well as ergonomic and anthropometric questions. These aspects are critically rethought to contribute for the reformulating of the shelter. Then, the way for the proposal conception is retaken, this time, with the representation of the project through sketches, diagrammatic, conceptual, structural, building details in scale models and digital models, trying to think and solve the issues surrounding those decisions (Fig. 7).

Second stage—Architecture of the senses: analytical study of an architectural project or built architecture that has the sound as an establishing concept for its design. Work done in pairs. This proposal aims to contribute for the development of theoretical and experimental knowledge of perceptual and sensory categories intervened in the design and architectural production. In contrast to the habitat experience, at this stage we look to experience architecture produced by architects designed in a conventional process, design and built work, of recognized quality, emphasizing the sense of hearing, through the exploitation of the 'sound' in the design of the architectural space. After the choice of projects/works, students begin their description, interpretation and analysis, recording their research through physical and digital models expressing conceptual, spatial, technical and constructive aspects of the architecture analyzed. Some of these aspects must be determined to guide the next activity: a spatial proposal, represented through scale models, drawings or animated films, based on concepts that were extracted and abstracted from the analyzed work. The exercise of transferring concepts and sensations from a proposal to another makes the student understand that the architectural idea is a theoretical tool and can be used in various spatial and formal differentiated solutions, without losing its genetic link with the reference work (Fig. 8).

Third stage—Prototype Experiment: Construction of Interactive Installation: architecture and sound. At this stage, theoretical knowledge and technical skills

Fig. 7 Individual habitat construction process. *Source* Authors' collection

Fig. 8 Construction process and individual habitat record. *Source* Authors' collection

worked in previous activities will be tested. This is, the design conception and implementation of an interactive installation that highlights the 'architecture and sound' relation. Initially, the student proposes a written narrative that expresses the spatial distribution of an idea, a questioning, a critique, whose intention should be taken as a concept and express the possibilities of the 'architecture and sound' interface. This proposal should consider the active participation of the public and its interaction with the work. The elements of the installation can be arranged within internal or external environments. The process seeks to reflect the complexity of an architectural installation, since its inception, its representation with the use of different languages, until its fulfillment (Fig. 9).

The use of various tools, such as multimedia features, performances, videos, films, computer graphics, digital or not, electrical and electronic devices such as sensors, video installation, among others, are part of the work and enable the realization of the proposal, that somehow shall interact with the senses of the audience. So, at first, the activity seeks to explore the research around the sense of sound as an establishing element of the proposal. Secondly, it was carried out a study of constructive and structural alternatives for the development of the conceived idea (Fig. 10).

The executive project is prepared and recorded in drawings, analytical scale models, construction details, etc. The whole process is recorded into a digital portfolio, which in addition to graphical records should contain material specifications and a budget. The final amount of the accomplishment must not exceed a common value, previously defined for all groups. Still at that stage, pilot-testing of devices and interaction tests are carried out. The redesign of some aspects is then possible, if necessary. The final stage corresponds to the construction,

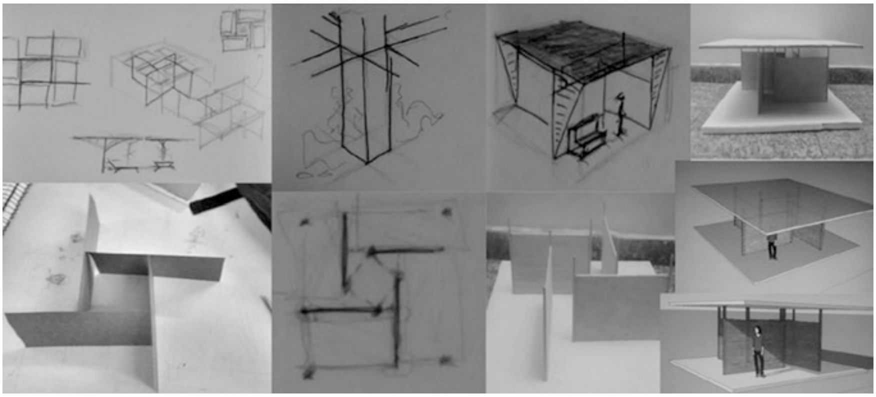

Fig. 9 Individual habitat analysis. *Source* Authors' collection

Fig. 10 Installation/performance. *Above* Group 'The felt sound'. Addresses prejudice through sound, the way it develops and is observed in society. *Below* Group 'changes': Explores the boundary between sanity and insanity from the use of artificial and natural sounds departing from the concept of labyrinth. *Source* Authors' collection

implementation and experience of the installation. Video recording is made of the entire prototype building process. The day and time of presentation of the installation is disclosed in different means. The presence of the public is expected in order to make sense of the facility. This interaction has the objective of exploring the senses, causing tactile, auditory, visual, olfactory, gustatory, spatial and memorable sensations, thus conferring meaning to architecture.

4 Final Considerations

The dominion of relations between theoretical and practical knowledge regarding their limits, or even, within a pedagogical perspective of integrated design, is not an easy task and consensual in the design studio. In Brazilian academic environment, until the mid-80s, the final project of the student was the only product of the course, through which the student would be assessed. The path taken by the student was still not valued as a component capable of measuring his or her research capability of a problematic as well as, of cognition and architectural design intent. The phenomenological approach to architecture came to value the process of 'how to do it'. In both experiments presented, the process of design research, as says Rafael Moneo (2008), is the 'responsible' way for the project, it makes architecture a didactic substance.

These two experiences seek to enable projectable entries that value the human senses as a way for design conception and architectural design project expression. If the architectural experience is a multisensory experience let its design contemplate this aspect. The results of experiments in the studio showed that the proposed educational process for the architectural production stimulated creativity and the perception of architecture predicates, both material and immaterial. The experience enabled the reflection on significant aspects of architecture, that go beyond the investigations around functional, aesthetic and technical issues, rather collaborate in the construction of the essence of architecture itself. Through the examples shown in this article, we seek to highlight the importance of new combinations of knowledge, techniques and skills for the conception and experience of architecture. We advocate an academic position that explores different ways for the design conception and perception of social space in architecture, valuing the participation and experience of the being as an individual or social group that has an essential part in the architectural production process.

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Vision(s), Process and Intention. Place Appropriation. A Teaching Experience in the River Guadaira

Mercedes Pérez del Prado

Abstract "*The project begins with the vision*". Sensibility and reason. It is crucial to dive into the *inner encounter* of students with a place and its architecture, barely guiding them, allowing them to discover the importance of both the *experience*, and the *need to reflect*, having a *complete awareness* of it. Developing a *tasteful* way of reflecting. How to achieve this in a cultural—sometimes vain—context of stress and utility? Mesmerizing students with surprising, puzzling, rhythmic, enjoyable elements… favoring situations resulting in creative processes. We share this teaching experience of place appropriation in three acts: *Discussion capture, analysis, and reinvention.*

Keywords Vision · Process and intention · Place appropriation

1 Discussion Framework

Back to EGA congress in Seville 2006 we considered that the projet began with 'the vision'. We established that visions build and are built. Learning and its relationship with observation was the starting point of such consideration. A way of learning that "aims to integrate our knowledge and our essence, and that is something which only the individual can do. This requires observation, in full awareness, diving ourselves in that vision, with love, with astonishment… First emotionally, then with a searching intention" Visions are always essential in an architect. Sensibility and reason.

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2 Didactic Background

Bolonia plan of studies, with four-month micro subjects, compels to emphazise one vision or another. Subjects in the first academic years focus on the analytic vision. *D.4 Ideación y configuración*, in the third year, considers crucial to dive into the *inner encounter* of the student with the architectural work and place, through minimal guidance. Thus, the student discovers the importance both in the personal *experience* and the in the need to *stop* and became *fully aware* of it. Therefore, developing a savouring vision.

How to achieve this in a cultural—sometimes vain—context of stress and utility? In an academic context where students are always in a hurry with tasks and projects…We try to mesmerize them with surprising, puzzling, rhythmic, enjoyable elements… favoring situations resulting in creative processes. Processes, experience-action-reflection-action.

3 Previous Background

During the first stage of the course, *Dibujar como procesos (drawing like processes)*, students explored *action* and *drawing*, experiencing them from the point of view of *silence* and *contemplation*: substances, smells, colors, sounds, and emotions at the Reales Alcázares, assimilating texts… exploring the light, playing with objects, bodies, frameworks… taking photographs… always *trying to make graphic what is intangible.*

While these experiences (exercises) were taking place, as an inflection in the rhythm and analytic counterpoint, the group developed another sequence: *Drawing as processes. Learning from masters*. This stage analyzed the purpose of drawing as an element of thought, trying to achieve a synthesis of the process idea-sketch-configuration-work.

4 A Learning Experience by the River

With this almost-new vision, with the heart and a loose hand, already familiarized with the masters, we ask the students for another synthesis: *Process and intention*. An *appropriation* exercise in three acts:

- *Scene capture in dialogue with…*

Students walk around contemplating… 'Accompanied' by the architects they have studied (Wright, Mies, Libeskind, Utzon, Zumthor…). First in silence, then 'dialoguing'… sharing all that catches our attention, all that touches our heart… and then trying to capture that in a photograph, a sketch, a note…

Fig. 1 Place appropiation. End of a process. "Movement and transparency. Box for experimentation" (Marta Nuñez and M. ªJosé Moreno)

– *Analyzing the scene.*

Selecting and discarding, choosing a feature (reflections, cracks, invasions…) and get back to work now tracing all its manifestations: situations, seasons, time, moods… to elaborate a cartography of that feature.

– *Rewriting the scene*

Making a personal, creative, though not arbitrary, construction. After choosing a feature, all the decisions and actions must be the expression of that scene, and be consistent with it. All decision must respond to a specific intention (Fig. 1).

This is the outline of the exercise; and this a final image. But what matters is the process we want to share… among professors, among friends, telling our experience these three years. Processes, tribulations, turns…

Place appropiation. Which space to choose? Recalling the feelings when reading Zobel's *Diario de un cuadro*, it was decided that the place should be a river. Re-reading the extract, at the very start, he wrote: "The landscape, water-vegetation-rhythms-spaces, was very rich and attracted me more and more"[1] (Zóbel 1994). This is a joyful introductory reading. As river Júcar was far away from Seville, another spot was chosen: the beautiful natural landscape of the river

[1]This is the translator's adaptation of the original quotation (ZÓBEL 1994, 11).

Fig. 2 Working by the river Guadaira on its way across Alcalá

Guadaira near Alcalá, with its *white flour mills*. Historically it has attracted many Sevillian painters. A second but far from negligible factor is that nowadays the place is well communicated, with a motorway and good public transport (Fig. 2).

Initially, this exercise started as a spot capture *under the vision of…* In groups, and after a previous search in Google, they students selected a section of the river to perambulate. They must identify themselves with one of the masters they have studied, in order to capture something related to the artist's sensibility, portraying or sketching in that specific fashion. The experience was fruitful due to the analysis results, but mostly due to each individual bond established with the master. After all, the analytic component dominated the desired sensitive vision. At the end of the course, in their final report, the students declared that they have would prefer the first person vision.

The next year we introduced several changes. The previous research was eliminated, as it generated mental filters and diminished spontaneity in the first encounter with the spot. The section of the river was chosen by the richness of possibilities and with an appropriate length for the goals: not too long, but with enough spaces to stop, sit, and be fully aware of the place. It was also established that the students at first would simply wander and relish alone. A second stage, in other terms, they should 'dialogue' with the artist.

Students were enchanted by the place, surprised, on their own –records were many. For example, one of the students wrote: "My watercolor sketching tried to portrait the textures perception and the colors which seemed important to capture the landscape, and I left aside the forms of shaped that framed it." (Fig. 3); In her dialogue with Herzog and de Meuron, she made pictures of fragments showing the *geometry hidden in nature*, and then the possible 'textures' of the materials, as later in the studio she manipulates *playing with the substantiality*, following the steps of those master architects (Zaera 2000; Mack 1997–2009).

Fig. 3 Scene capture in dialogue with… Herzog and de Meuron (Marta Gavilán Méndez)

A whole dialogue of visions, sensibilities, and interests discovered by the students when dealing with the artists' writings and drawings. Sometimes related to their direct connection with nature: Utzon thinks of it as a *laboratory* (Puente 2010; Weston 2008); sometimes related to a project strategy, as Libeskind's concept of *line and 'voids'* (Bates 1996; Libeskind 2008); and others to our inner poetics, as we can imagine ourselves taking a walk with Zumthor by the river, watching *the light beams upon nature* or stopping to listen to *the sound of space* (Zumthor 2006; Durisched 2014)…

All students enjoyed it… A day in the countryside, in the midst of the term, it is always stimulating…

Photography satisfies the eagerness of capturing all. Students are asked to go for the detail, and do it deliberately… Drawing and sketching means to stop and sit, now quietly. The results show that, above this framing methodology, fragments, details, zooms… there is a vision that savours all (Fig. 4).

It is very important to separate this first act from any later projection. The intention must precisely be un-intentional, the vision must lack of all 'utility' in order to find, not looking for; more than capture, students must be *captured by the place*. Therefore, this approach is rather free and loose (students are not still provided with next requirements). References to other courses are not valid from one academic year to another… students never know which new elements will be introduced.

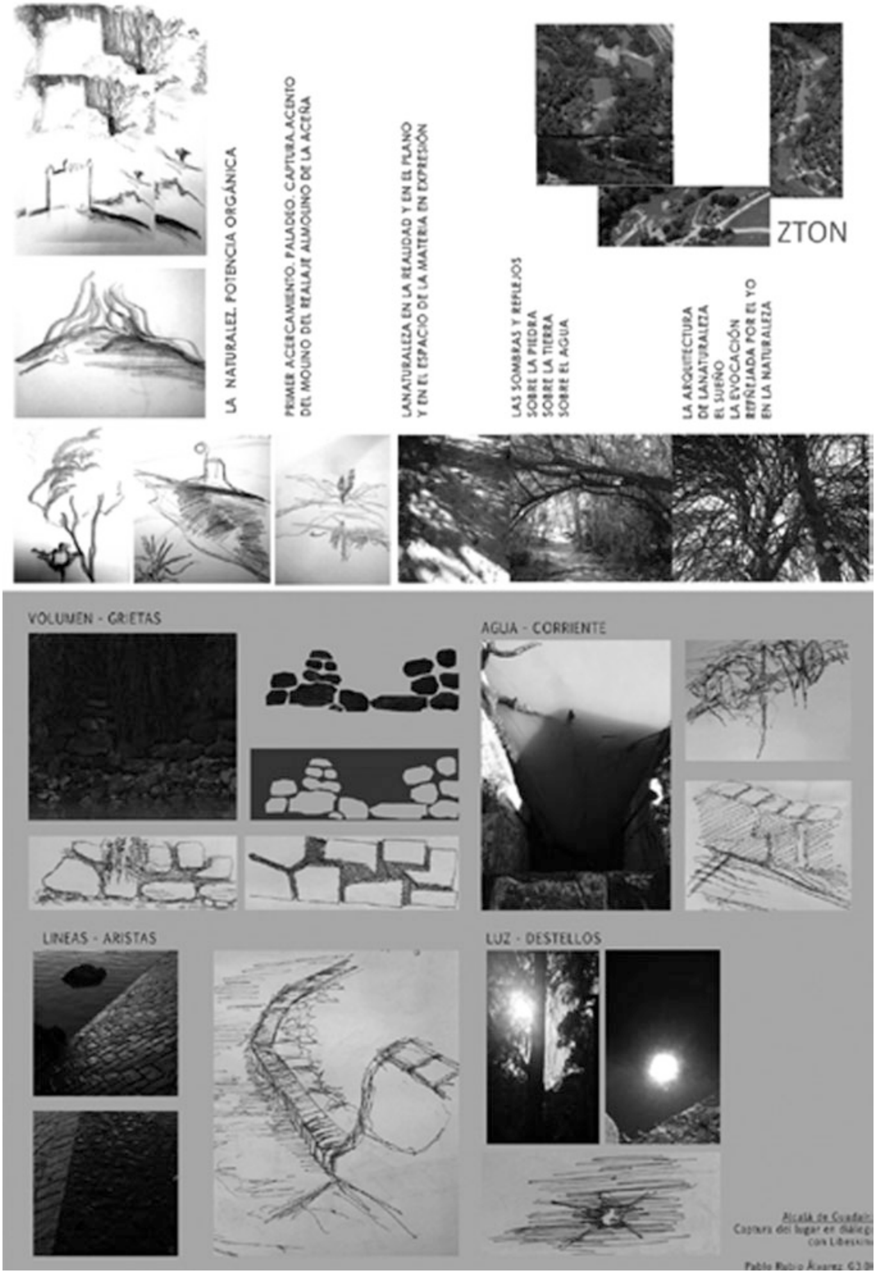

Fig. 4 Scene capture in dialogue with… Utzon (Sandra Alonso de Santolcides) and Libeskind (Pablo RubioÁlvarez), respectively

In the classroom, after sharing the experiences and discussing them, the second act takes place: *Analyzing the scene*. Students work then in pairs, according to their choice of masters, their similarities, and the features highlighted. Then, they have to select one feature or combination and, back to the place, find the different ways and situations in which they manifest themselves.

A pair of students chose the combination *shadows and reflections*. With some notes on their drawings, they comment the process: “It is a study upon the shadows… their diversity… the shadows on the earth, well defined in black and white. The shadows on the river, colorful and diffused…” (Fig. 5).

Now, this comeback to the spot, this ‘cartography’ of features, it is elaborated to achieve a creative, personal construction. Students know this beforehand. Thus, they can note down questions such as “The river must be identified. Which plane to use, horizontal or vertical? Which background?” (Fig. 5)

In another exercise, *Cracks* (Fig. 6), they write “Pavement: medium crack, texture, break; current: movement, changing, directionality…” Classify. Light that travels through cracks and thickets. Little spots in the earth or lines in the barks let the beams flow… in the pavement, the river ‘crack’, and the cracks in the river, lines on the current, deep in the mills, bird marks…

Proposing second and third act at the same time, a horizon for the project analysis, provided a new conception, and it motivated the student to go back to the spot. The introduction of this course novelty was a success. *Rewriting the scene* not just through a—always creative—personal vision, but through a more tangible construction.

A creative, personal—though not arbitrary—construction. Once the feature is chosen, all the decisions, all the actions, must be an expression of the spot, must be coherent with it.

Students were allowed to work on a ‘thick format’ (A3 maximum length and 5 cm thickness) in free technique. However, each choice must correspond to a specific intention… They really enjoyed making tridimensional objects, sometimes ‘artifacts’ as this example which introduces an inner light, to show not just a type of

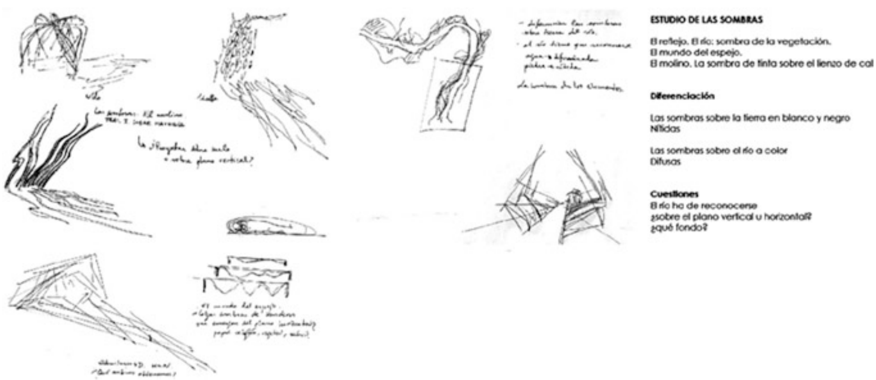

Fig. 5 Analyzing the scene. Features: shadows and reflections (Sandra Alonso de Santolcides and Gloria Guisado)

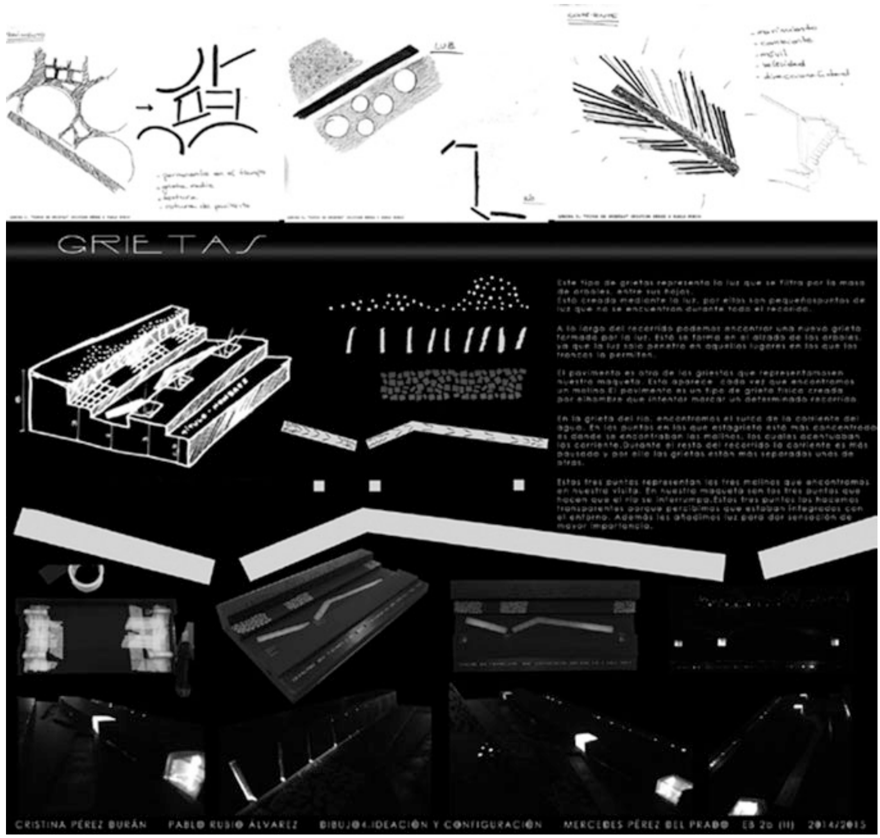

Fig. 6 Second and third acts. Libeskind/Cracks (Pablo Rubio Álvarez and Cristina Pérez Durán)

crack, but that the very white mills shine with the sun (Fig. 6). Or mobile elements, such as the "Box for experimentation" portraying movements and transparencies in the river (Fig. 1). With subtle prominences, or completely flat. All made with all kind of materials frequently combined with manipulated photographs.

Initially, the format conceived was an A2, then the prototypes were made in A3 format. Finally, we determined the suitability of the later, as it is a more adequate format for graphic expression, and more flexible for constructions. By the end of the course term, this fact is something to take positively into account.

Going back to the work entitled "Shadows and reflections" (Fig. 5), these students continue their approach introducing the game "reality and unreality/shadows and reflections", explaining: "Reflections and shadows as reality. Reality as a mirror, reversed, an imitation of a new reality of shadows. We drew the river, its shape, by means of the jigsaw puzzle of manipulated photographs aiming to the intention already described. They expressed the shadows on the earth with black and white defined photographs; in color and diffused for the river. There are a lot of rehearsals on the images, their composition, their background, etc. (Fig. 7).

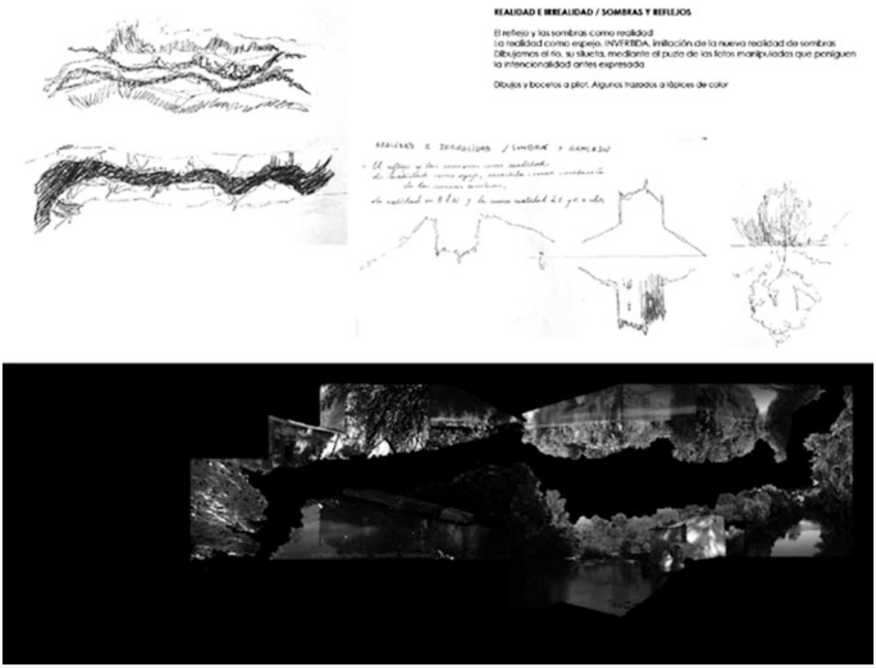

Fig. 7 Rewriting the scene. Shadows and reflections (Sandra Alonso de Santolcides and Gloria Guisado)

Answers are numerous. The most interesting part, as in the whole year, is *the process*: rehearsals, discussions, decisions, shiftings…

Also, we wanted to mention another work, as its authors, in the same fashion of the previous model commented, started their capture of the spot in dialogue with Utzon, who they have previously studied. Both pairs of students chose *reflections* as their second feature of analysis, but they explore very different paths, going beyond the main feature: shadows in the first case, *color* the other pair. Process is depicted below.

Captivated by color, their initial idea was the creation of a topography made of colorful wood sticks: color imitating the ones in the nature, a white band representing the mills. Reflections could be blurred photographs… What about the nature of the river?… "Mills are singular intersections; the water changes in those points: from peaceful and clear at the bank, then violent, loud, with movement in the mill." Swerves, inflection points… *struggle* with the river shape, its format (Fig. 8).

The students went back to the reflections theme… they were interested in evocate one particular spot of the river… As with eyes half-shut, they took some

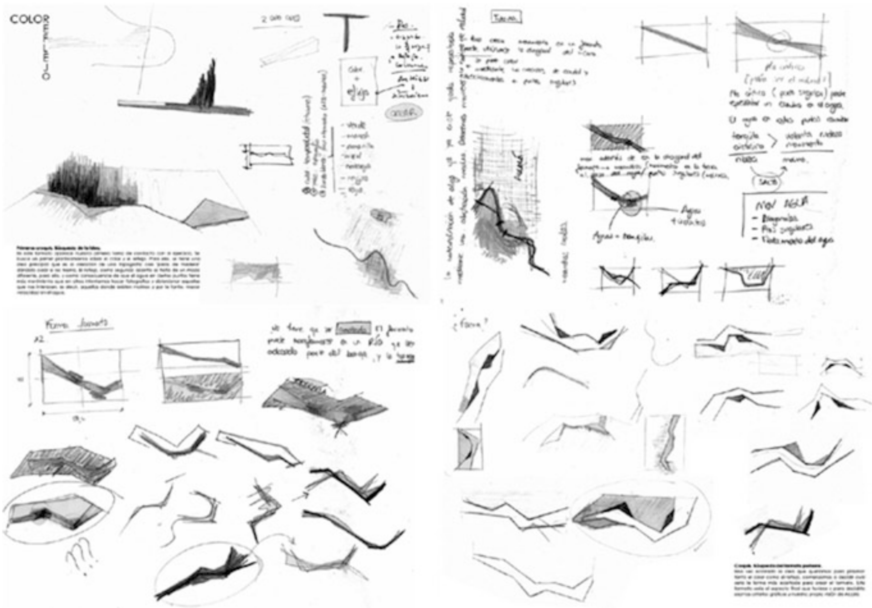

Fig. 8 Third act. Process (I). Color/reflection (Carlos Girón and Francisco Javier Guillén)

pictures and alter them… tested photographs of their demo to create relections… Finally, they used images of the construction differentiating "the singular spots in the river: mills (movement, speed) by means of a process of image distortion, the riverbed (peacefulness, calm) by means of an immediate reflection" (Fig. 9).

The final result of this work is appealing, though it embodies a particularly complex execution. The process, with its abstraction levels, struggles, and cohesion was interesting (Fig. 10).

Many other exercises could have been included, having rather suggestive features, as *the geometry hidden in nature, the human colonizes nature/nature colonizes humans, the itineraries, textures, the way tracks are left*… Not always the processes were interesting, but the work compilation would be endless.

5 As a Conclusion

During the explanation some conclusions have been presented. No doubt each individual. However, a few strategies may be highlighted as very helpful to challenge and motivate students in this journey.

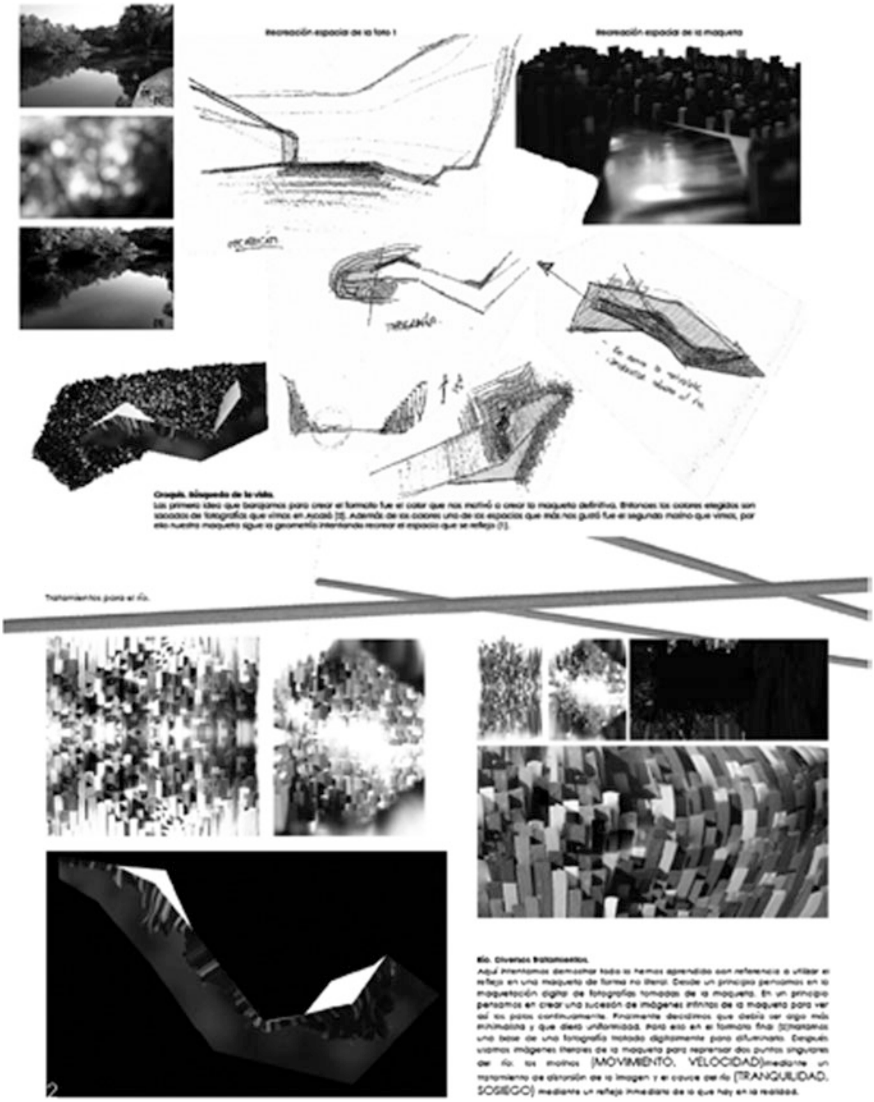

Fig. 9 Third act. Process (II). Color/reflection (Carlos Girón and Francisco Javier Guillén)

Professors consider crucial to present this subject in terms of enjoyment and creativity… Students must spare time, amidst all the stressful academic activities, for a joyful –even in its complexity– subject to be dealt with, in a ‘nice’ atmosphere… Making this subject “a mandatory oasis”, “a breath of fresh air”, and “the break they needed”, just as the students themselves claimed at the end of the course.

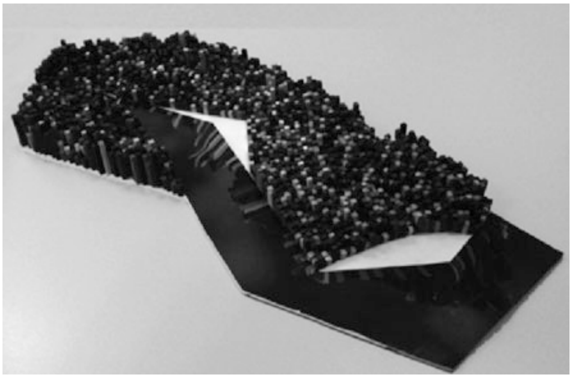

Fig. 10 Third act. Construction. Color/Reflection (Carlos Girón y Francisco Javier Guillén)

Setting the goals gradually, playing with surprise and changing rhythms, forces the students to focus entirely in their task, discovering its value in the midst of the very action. Then they go back to reflection, then to action again.

Introducing in different stages both personal and groupal, shared experiences. Going to the place for the first time on their own… being without the group, alone, facilitates a silence without interferences so necessary to undergo a calm experience. It is important for the students to be unaware that a later visit with the group will take place, thus avoiding that in their efficiency they try to 'kill to birds with one stone', letting the noise and rush to appear.

Mixing photography and drawing. During the course, photography has opened the way for students to test, experiment, evocate, retain… in a dynamic, agile manner, but quietly at the same time. Once the students undergo this experience, they 'sharpen' their visions portraying their new knowledge by means of drawing. Putting an end to the process of abstraction and creativity.

Finally, we must highlight as equally important that as well in the first encounter with the place students should be entangled in the spot—captured by it, free, avoiding later projections–, we also consider a good choice to provide them with a certain project horizon for the analysis; because it both encourages them to go back to the place, and also provides sense, not only, to both encounters, but to the course as a synthesis.

To enjoy, get surprised, test, struggle… revealing next steps every week to create some sense of bewilderment… working by themselves or in pairs, discussing in groups… always sharing and reflecting upon experiences and actions… Students worked hard, gladly and joyfully, with a purpose. Process and intention.

But, above all, they developed something more than that savouring vision: the capability of taking time to stop, and listen quietly… and to combine it naturally with the other vision that intentionally looks for and tests. There are both essential visions in an architect, then and now.

Be one with the place, in a playful process of sensibility and reason, as *the project begins with the vision.*

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Teaching to Think Through the Hands a Teaching Experience About the Use of the Scale Model for Architectural Design

Manuel Giménez Ribera, Jorge Llopis Verdú, Ana Torres Barchino and Juan Serra Lluch

Abstract In the contemporary architectural environment, characterized by the massive introduction of computer graphics in the design process, the attention is caught, even in offices regularly proposing extremely formal complexity designs, by continuity in the employment of one of the oldest ways to display architecture and design: the three-dimensional model. In the "Análisis de Formas Arquitectónicas" course at the UPV (Spain), an articulated teaching methodology has introduced the use of the model to complement the sketch learning, as a graphic mechanism of formal comprehension for the architectural object.

Keywords Model · Sketch · Learning

1 Introduction

In the contemporary architectural environment, in which the use of three-dimensional computer modelling software has become an omnipresent mechanism for formal manipulation and architectural representation, the attention is caught by what we could name as the rebirth of one of the oldest means of expression: three-dimensional models. Architectural offices characterized by the extreme formal complexity of their projects, such as Frank Gehry, Zaha Hadid, Daniel Libeskind or EMBT publish, as previously done with hand-drawn sketches,

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Fig. 1 Frank O. Gehry's office in Santa Mónica. Louis Vuitton Foundation scale models

series of photographs that show scale models of ongoing projects, which are introduced as the means of manipulation used by the office to supplement the computer graphics that characterize these days.

Architectural practices, that looked like computer labs since the 80s, now seem medieval workshops in which a number of architects, designers and students strive to give shape to the ideas, before or simultaneously to the computerized manipulation. Thus, a way of working in which the practice of manually developing scale models plays a key role in the formal ideation of cutting edge architecture, whose creation and construction has been possible only through the use of computers and modern software, often imported from other technical disciplines or designed for other sciences, often out of line with architecture itself (Fig. 1).

Faced with this paradoxical dualism between innovation—represented by the modern software used for creation and formal manipulation, and tradition—represented by the survival of sketches and scale models, the eldest tools of the architectural project—it bears asking about their roles in the development of contemporary architecture, as well as whether or not to preserve the learning of these traditional techniques in the training programs of architecture students in our faculties, and the need to set up teaching strategies that allow the students understand the reason for the survival of these manual techniques in our modern digital world.

2 About the Use of Scale Models in Contemporary Architecture

> Any movement of the hand in each of its works is directed in this way through the element of thought, its expression and gesture come by way of this element. All work done by the hand rests on thought.
>
> Martin Heidegger (2005, 79)

The persistence of the use of the scale model, as a physical and tactile experience within the architectural design process in the strongly digitized current environment, is not a paradoxical fact, but the evidence of the limitations of the computer to fulfill efficiently the requirements of every phase of design.

We could say that without the computers and modern software, the new architecture would not be possible, but the use does not completely displace the usage of traditional graphical techniques based on the direct application of hand gestures, for the characteristics of the digital world represent an estrangement between the hand, which is the basis for a great deal of our cognitive processes, and the resultant formal world. The thesis we hold is that the reason why architects like Gehry, Hadid and Tagliabue, characterized by manipulating a formal universe impossible to control without the computer, keep on using sketches and scale models is because they cover the need for a straightforward connection with the project, of tactile nature, that computerized graphical manipulation does not meet.

The existence of an intimate relationship between the eye, hand and mind is at the basis of modern psychology research. Authors such as Vigotsky (1978) provide evidence that the use of hand gestures plays a fundamental role in cognitive development in the early ages of humans. Touching, manipulating and interacting with the environment through eye-hand coordination, we perceive the world and develop categories that are at the basis of our own intelligence. This is what authors like neurologist Frank Wilson define as "*nexus hand-thought-language*", and to bring him to state "*any theory of human intelligence which ignores the interdependence of hand and brain function, its historical origins or the influence of this history on the dynamics of the development of the modern human being is, in general terms, erroneous and sterile*" (Wilson 2002, 21).

Contemporary authors such as Richard Sennett or Juhani Pallasmaa stress on this line as they analyze the role of traditional production techniques in the contemporary world and the tactile character of architecture as well as the effects of estrangement between hand and brain in the architectural field produced by massive digitizing.

Richard Sennett focuses on sociological considerations, emphasizing the estrangement that the virtual digitized world causes between productive activity and reality. In his book *The Craftsman*, Sennett notes that the use of computers is causing, in many cases, the disappearance of the circular experimental test process in architectural design; this process explained by many architects that, as Renzo Piano, described the design process as the way from the sketch to the drawing board, to the scale model and back to the sketch. A process in which the indeterminacy of manual drawing acted as a trigger for the creation of forms, and that the extreme accuracy and the need for precise determination which characterizes the CAD has shelved.

> The tactile, the relational, and the incomplete are physical experiences that occur in the act of drawing. Drawing stands for a larger range of experiences, such as the way of writing that embraces editing and rewriting, or of playing music to explore again and again the puzzling qualities of a particular chord. The difficult and the incomplete should be positive events in our understanding; they should stimulate us as simulation and facile manipulation of complete objects cannot. The issue—I want to stress—is more complicated than hand versus machine (Sennett 2009, 61).

Sennett's speech is not nostalgic, but proposes removing the mysticism of computers and virtuality as a paradigm for the future, as well as some negative effects that are already visible nowadays. Sennett denounces an epic discourse about the new globalized and digitized world which he considers similar to the messianic late nineteenth century machinism, suggesting a relativism about the machinist triumphalism of this era, but without casting doubts on the progress the computer means in many areas. To Sennett "*Abuses of CAD illustrate how, when the head and the hand are separate, it is the head that suffers*." (p. 61), that is, the uncritical use of computers may cause such a rift between the hand and the critical evaluation processes that it leaves us defenseless facing the requirements of the software itself, taking away from us the control of the process of production to make it depend on the characteristics of the tool itself (Fig. 2).

Meanwhile Juhani Pallasmaa develops a discourse based and focused on relevant issues of architecture. To Pallasmaa "*the tactile*" is a fundamental part of the architectural experience and the massive use of computers tends to displace this tactile character in exchange for an essentially visual experience, so that the computer breaks the connection between imagination and the object (Pallasmaa 2012, 74). We can say that computerized *making* differs significantly from manual *making*, and its widespread implementation determines the result through the

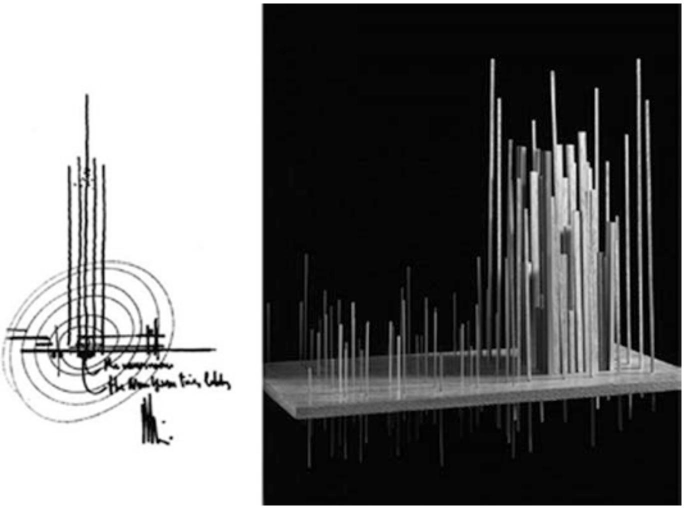

Fig. 2 Renzo Piano: Sketches and scale model for The New York Times Building

characteristics of the graphical tool used. To Pallasmaa "*To argue that for the purposes of drawing an architectural project the charcoal, pencil, ink pen and computer mouse are equal and exchangeable is to misunderstand com- pletely the essence of the union of the hand, tool and mind.*" (Pallasmaa 2012, 54).

The scale model would ensure the preservation of this link between eye, hand and mind, bypassing the visual rift that the computer imposes in our design processes. It would avoid, at least partially, that the computer routines prefigure the final forms, stemming their creation directly from manual handling and preventing them from being set at the beginning by the formal catalogue of the software used.

3 The Spanish Pavilion in Shanghai and the Conceptual Use of the Scale Model as a Design Tool

To illustrate the use of scale models in the design of highly complex architectures, we propose to analyze a unique case in which their use meets conceptual needs and complements the digital tools by way of using a technique that prioritizes materiality and tactility opposite the virtuality of computerized design: The Spanish Pavilion at Expo Shanghai 2010.

Its formal complexity and the extreme difficulty of its constructive realization require the use of complex programs that enable both the graphical definition of the final design and the material definition of many different construction elements. However, the design process of the building, as the office itself has been responsible for publishing, depends as much on these digital tools as on the use of scale models to determine the building from its early stages and enable successive approximations to the final result (Fig. 3).

The building is designed based on the formal analogy with wicker, understood as a common metaphor of both Spanish and Chinese handicrafts. From this formal ideation the building is materially conditioned. It is not only about coating the building with wicker as boundary surface, but materializing it from a structure that operates similarly to the traditional basket making. EMBT has developed many three-dimensional models, made of different materials depending on the design goal. Thus we find scale models made of corrugated cardboard, built by successive horizontal slices to determine the overall shape of the building, to which must be added scale models of "wired" character, which allow to adjust the form through the warping of the mesh, as well as to predetermine the steel structure designed using a tubular mesh that supports both the glass envelope and the subsequent coating of wicker sheets (Fig. 4).

The material used in each scale model is not unimportant, on the contrary, it prefigures the final design and ventures hypotheses about the formal and structural problems that will turn up in the project. This seems clear in the case of the structural mesh aforementioned, characterized by the linearity of the wire, input data for the subsequent computer calculation, allowing to continue the modeling

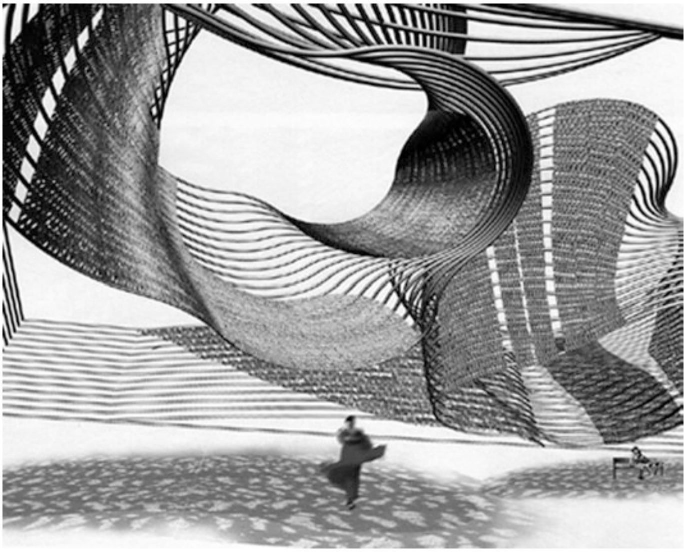

Fig. 3 EMBT: Spanish Pavilion in Shanghai: concept image

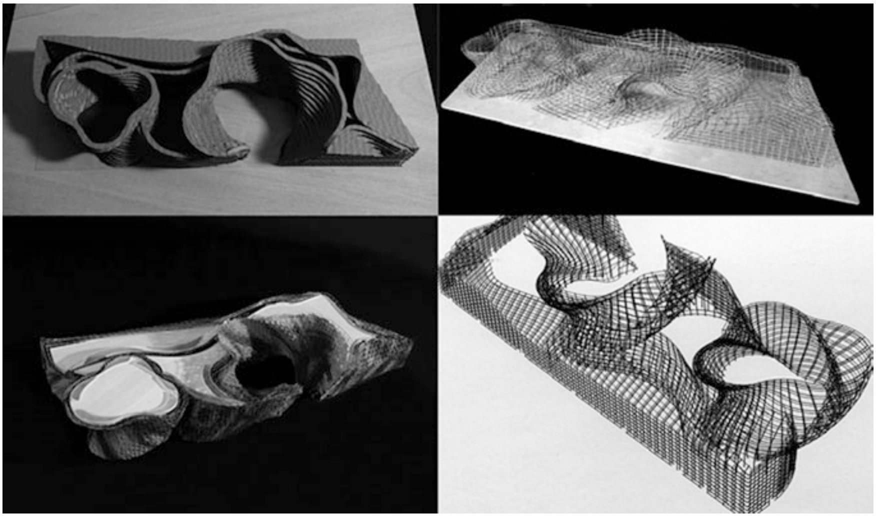

Fig. 4 EMBT: Spanish Pavilion in Shanghai: design scale models and digital rendering

and formalization process of the design project. A similar process, characterized by the simultaneous and complementary work in three-dimensional physical and computerized models, is used to determine the various elements of a smaller scale, as the individual wicker pieces that will form the final cover.

The use of the scale model of the Shanghai Pavilion in order to define the design ideas seems to be strongly related to the gestural idea of the building itself. It is clear that the scale model allows a clearer approach to the form and the final image than any computer program, so that there is an almost linear relationship between the previous results of the manual model and the final result. But there is another aspect that we understand as essential, direct experience with wicker and its performance, which provides an indispensable information to understand the way in which the building must be designed. Touching wicker, give shape to it, understand its texture and color under the light changes, develop the braided material and experience the features of its different degrees of transparency is a direct experience that no computer program can replace.

The scale model lets us "understand" directly the mate- rial and its behavior, braiding wire, anchoring them to the metal wire frame and twisting the final layers. It is a similar experience to that of the direct understanding of brick and stone which characterized architectural training in the preceding centuries, in which idea and construction were directly related to each other. The computer separates direct tactile experience and form, which means that in many cases the resulting forms lack material consistency. The scale model, however, allows direct connection with the built object, is an experience that relates directly to all our senses, and not just with the visual. Its use complements the computer giving back the feeling of the material in an environment increasingly characterized by virtuality (Fig. 5).

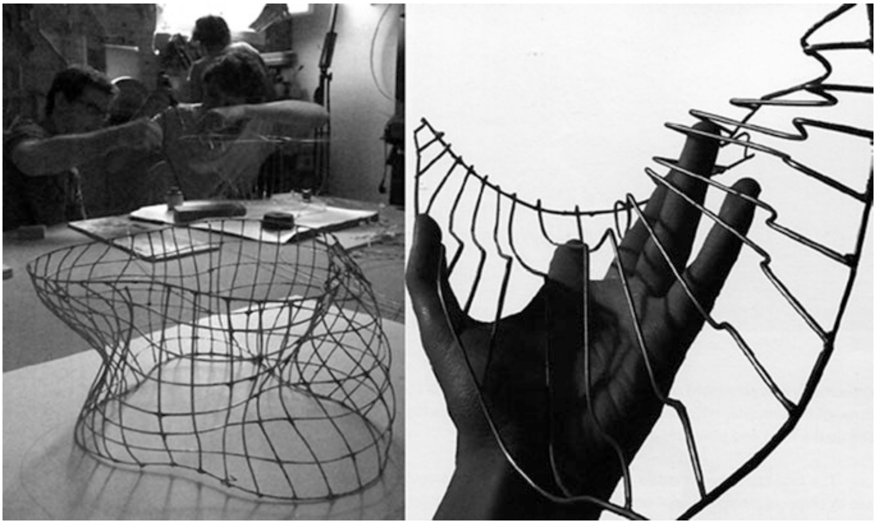

Fig. 5 EMBT: Spanish Pavilion in Shanghai: EMBT scale models workshop

4 Scale Model and Sketch in Análisis de Formas Arquitectónicas Course

Teaching in schools of architecture should deepen the students' understanding of this integrated approach, which coordinates the use of graphical tools, computerized techniques and three-dimensional models, to ensure the continuity of tactile strategies in an increasingly digitized graphical environment.

Our first year students, at least of the Análisis de Formas Arquitectónicas course, on the last section of the school year, undertake the mixed-use of drawing and scale models. This approach is undertaken once a series of graphic skills have been acquired during the first semester, having faced the first formal analysis of a renowned architecture. With minimal graphical prowess and after a first approach to the architectural idea implicit in the analyzed model, the last step prior to pass the course is the aforementioned circular experimental test process, formulated by Renzo Piano: concept sketch—scale model too, drawing board—naturally also computer—and back to restart the process, in a circular knowledge, understanding and corroboration process.

One's own hand will be responsible for transmitting the ideas acquired in the mind, while the eye reviews, confirms the validity of the generating ideas for the apprehended project.

This graphical process must be agile, quick, analytical, and so it serves as much a drawing as a scale model. Both mechanisms must contain an expressive synthesis able to recognize the analyzed architecture, be it in a few lines or with minimum dimensional elements; both should become an instrument for knowledge, able to summarize the genesis drawn, unequivocally, of the essential elements; both must structure the students' research within the design process, now somebody else's, subsequently his own, graphically confirming a cognitive abstraction. Ultimately, the students must analyze the generating ideas of a particular architecture, using lines, cursorily chosen, as well as simple models created with materials chosen by them, of an appropriate scale and arranged forming a synthetic volumetric discourse. These are, therefore, small size models, made with the appropriate elements, generating a specific object, a small sculpture that helps recognize the abstract signs that shaped the analyzed architectural object.

Pedagogically, this three-dimensional abstraction of the studied architecture allows the procedure to rethink the designed object and to transfer the primary concepts to the next step of the graphical process, where intentions are studied and confirmed time after time. This teaching system provides the student, through exploration and verification, with the answer to a professional need, acquiring a systematization of work, essential in the architectural practice, as it has been made clear in the aforementioned cases of renowned professionals.

In the case of the School of Architecture of Valencia, the teaching experience carried out in the Análisis de Formas Arquitectónicas course, designed to introduce students to the set of graphical tools to develop design processes, has focused on three types of three-dimensional models and their relationship with sketching and manual drafting.

First of all, we work on the use of concept scale models to complement the sketch as a tool for formal manipulation. This dualism is especially cultivated in the cases where the complexity of the analyzed architectural model requires a combined use of both tools, in order to provide students with a clear understanding.

These are not finished scale models, detailed or complex, but simple approaches aimed to understand the formal structure of the whole, with special attention to the complex joints or connection to the site in those cases in which topography is hard to model for a first-grader. Thus, the scale model is a direct extension of the sketch, as much for its abstraction level as for the direct relationship with manual gesture. In both cases the student "manipulates" forms to understand, going from one to another continuously. And in both cases the manual dexterity is secondary (Fig. 6).

Manipulating geometry to understand the architectural form of the analyzed building proves to be a process in which we emphasize during the first semester of the school year. Geometrize information, reaching an abstraction in the floor plan, elevation and cross section drawings, leads to graphically construct a volume—the axonometric system is the method most commonly used—with the essential parts of the analyzed building. The handling of the scale model elaborates on reducing to the minimum the elements with which we generate the form, and without which we would be describing a different building.

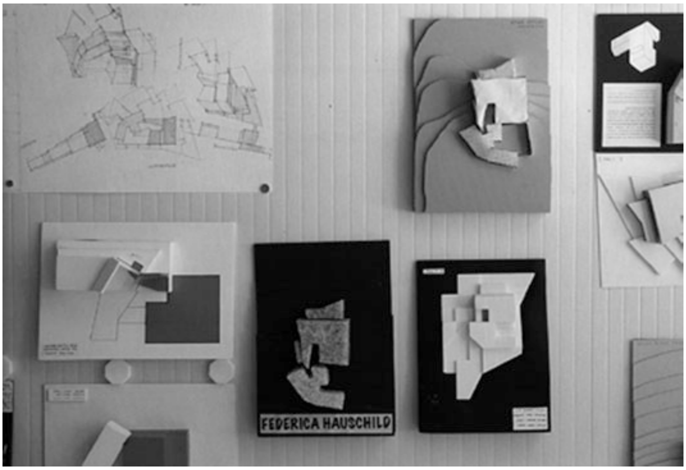

Fig. 6 Scale models as a complementary strategy to sketching in order to analyze the formal structure of the architectural object

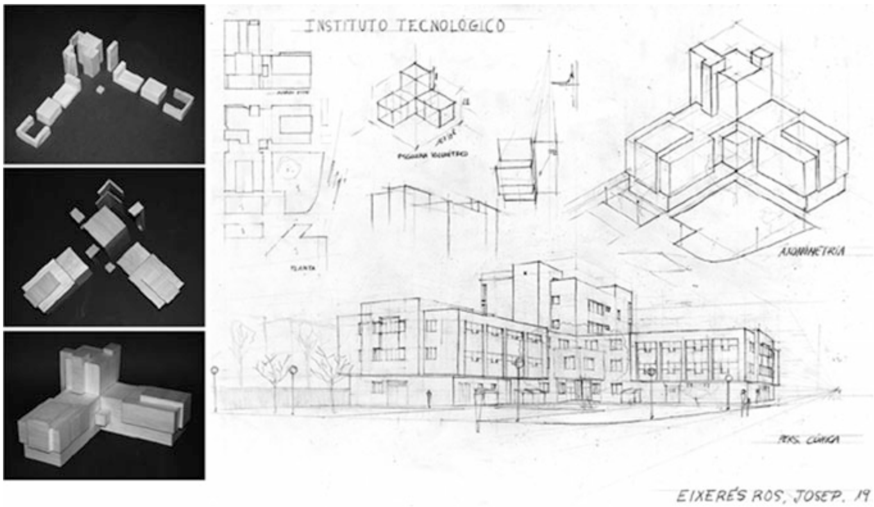

Fig. 7 Model of material research. Work of an *Análisis de Formas Arquitectónicas* student

This formal understanding ability, with the hands by drawing—two-dimensional, through the scale model—three-dimensional, enables the student to take the next step, which is none other than the fulfilment of a conical perspective, the representation of how the viewer perceives architecture. Abstraction, formal analysis through orthographic projections and the axonometric system, is reinforced by carrying the learned geometries into physical objects that are spatially combined in a scale model that allows the visual tour of the whole architecture (Fig. 7).

A second strategy developed in the course seeks to introduce the material factor in the analysis of the architectural object, transcending the mere graphical representation of textures. It is about introducing students to the constructive strategies through the experimentation in the materializing of the models. As in the previous case, the priority is not the material "mimesis" of the model but urge the student to reflect on the close relationship between the material and formal perception. The students are encouraged to experiment with different materials, rereading the original volume with other materials textures, analyzing the variations introduced by comparison with the scale models developed by other students, and all beginning with a conscious discourse of what the student intends with the changes.

It can be added a new interpretation caused by the conscious choice of the new material with which to build the scale model; by reducing the use of materials, depending on the concepts or ideas of the architectural object to relate, a material can lead to discover the footpaths as the main design idea, and the same material, used by a different student may describe the wired structure of the architectural forms embedded in the same place. Some cardboard contour lines made with metal representing the foot and car tracks, indicate a different design idea than a simple cardboard volume of the surroundings and some architectural geometries formalized in metal, discovering a bridge as design idea.

Being academic works developed on actual architectural models, analyzed with manual and graphical means, this sort of scale models represents a transition between the models of formal manipulation described above, and the design process models. They are an introduction for students to the visual characteristics of the form and the need to develop a design reflection on the constructive and material features of architecture.

The third and final type of scale model introduced in the course refers to the use of three-dimensional models as a mechanism for formal research, bringing the student closer to a conceptual use of a three-dimensional model as a trigger for the formal search that characterizes traditional sketching. These are abstract tests that combine the graphic character of sketching, with the material nature of the scale model. In these models, the formal search is entirely subjective. It does not necessarily refer to built models, as the aim is not to represent any architectural form. It is about helping the students to understand a double feature of the use of drawings and scale models. On the one hand it is intended that the student visualizes the way his sketch comes into being, interconnecting the two-dimensional image of the drawing with the resulting three-dimensional forms. Second, the students should understand the potentiality of both tools as conceptual mechanisms for formal generation, generating forms, both through drawings and scale models, in an arbitrary way, typical of the way in which some contemporary architects use both tools before introducing the computer in the process of material formalizing of the idea (Figs. 8 and 9).

Fig. 8 Model of material research. Work of an Análisis de Formas Arquitectónicas student

Fig. 9 Conceptual scale model. Work of an Análisis de Formas Arquitectónicas student

This set of teaching strategies intend to introduce students to the different objectives of the use of the scale model in contemporary architecture, understood as part of a complex design methodology, in which its relationship with manual sketching, both depending directly from hand gesture, while they come to complement the use of modern computerized tools, building a bridge between traditional graphical mechanisms and computer graphics, avoiding a rift that will preserve our inner need to use the hand to weigh and understand the world.

5 Conclusions

In the Análisis de Formas course, we consider—we might also use the verb to pull for—a teaching strategy capable of dealing with the duality between innovation and tradition; this is, maintaining learning through software and complementing it with traditional manual techniques. Both mechanisms of formal manipulation and architectural representation coexist in our classrooms covering all phases of ideation, understanding and design of the architectural form.

This integrative approach starts after acquiring a series of graphical skills, developing subsequently drawings and scale models of a built idea, recovering the conceptual circularity: analyzing the generating ideas of the selected architecture, abstracting its primeval concepts, to close the process corroborating intentions. The three-dimensional model, graphical manipulation and computer graphics complement each other and achieve, working in parallel, the learning of the formal ideation that was present in the chosen cutting edge architecture.

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Research About the Use of Audiovisuals in Architectural Configuration and Communication Learning

Angelique Trachana

Abstract The experience presented here is drawn from an Educational Innovation Project. As part of the project we have introduced a series of exercises in experimental formats in the *Drawing, Analysis and Ideation* workshops 1 and 2. They led us to investigate and theorize about the learning process from the perspective of creativity. The purpose of our research is to encourage creativity through intuitive learning as opposed to the concept and the analysis. In this sense, we have seen that the use of tools such as audiovisuals, which have a very familiar and everyday language for students, helps to increase their chances to undertake configuration processes and communication skills while at the same time they develop their conceptual level.

1 Intuitive Learning

It was not the first time that we have experimented with audiovisuals in the core subjects of the first year as well as the optional ones and experimental workshops. Assuming that the learning that concerns us is the configuration and communication of the experiential space of human beings, the video not only provides us the virtually built real space experience, it is not just a means to represent reality, but also to build it. This hypothesis leads us to experience how it may be a means of prospection of reality and of an architectural project. In opposition to the static configuration media (manual or digital), the video introduces movement and human action, which are functions of time and duration, as well as sounds. Audiovisuals can be a fantastic tool to design the architectural space understood here in all its parameters that define it as a living environment.

Through audiovisual editing in our workshops we aim to develop resources and experiences for architectural understanding and inventiveness whilst intensifying

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the perceptual and creative abilities of the students. The audiovisual in opposition to the conventional architectural representation and the photographic art, helps us to move, transfer and put into motion our static concepts. It also incorporates another fundamental factor that is the *rhythm*, the temporality of the cadences of the images and events, where architecture sometimes works as the main character and other times as a background. In these processes the innovation is not so much focused on the object projected, but in the understanding of space constituted by the action, by the bodies in movement and not as a recipient of the action.

From this point of view which focuses on people and events, the configuration process of architectural spaces, which are full of experimental and creative possibilities, stands in opposition to the method of analysis and the concept. The objective is to introduce the students to the project's processes in an intuitive, sensitive and entertaining way while delving into the authentic nature of architecture itself, at the same time developing the students' abilities and graphic-communication skills while they learn how to use different means and tools. The combination of film techniques together with more specific knowledge of the architect's tools, involves a wide range of cross-disciplinary and instrumental knowledge. Among them is intersubjective communication, emotion and sensitive perception.

These statements endorse as we have already said, by experiences in different scenarios of the graphic expression teaching where we develop strategies that include tools such as drawing, modeling, image processing and audiovisuals and where at the same time we introduce basic notions of architecture, references and generic expertise in communication, image, culture and the media. We do not intend to simply enter into the process of the form but also to provide it contents and meaning. Learning that involves these creative processes is initial and basic but has to accompany the trainees throughout all their career and life. Our intention is to introduce the student to the complex thinking of the architectural project by exercising the double bond "draw/project". Here, we understand "draw" in the broadest sense of the word, including all manual and technological procedures for the configuration and generation of images. Within that broad framework of expression, the audiovisual is the most effective means that articulate the intangible aspects of the architecture, discovering values, qualities and properties of the space that are not possible to visualize and transmit through static media.

In addition, with audiovisual exercises we introduce a certain informality and transversal learning process with which we intend to enhance the motivation of our students. At the same time we widen their training by diversifying processes, exercising new procedures, linking processes with research and experimentation, encouraging the exchange of information between disciplines and promoting dialogue between theory and practice. We also encourage the diversification of places for learning outside the classroom, in the real world; the collaborative production of knowledge, whilst we implement innovative processes and investigations about architectural teaching methods that are more suited to our times and the resources available. Our method of learning innovation lies in enhancing intuition against conscious cognition, the analytic-deductive method and rational processes.

The practical and intuitive learning using the means of expression such as the audiovisual, combined and complemented with the usual ones, as we have checked by the results of the work, allow us to be more efficient and develop our students' creative levels better; and their intellectual and emotional capacities at the same time.

Although the everyday audiovisual language is familiar to them, at first they do not know how to handle it, but they learn easily, overcoming the technical difficulties and able to develop their own poetical style. At the same time we can reel off complex concepts through their own work. Mainly students learn to look, they train their sensitive way of looking and through montages they learn to create new situations. As Vertov and other great filmmakers have taught us, the camera can see much more than the simple glance. When capturing fragments of reality which are then organized into sets, they show a deeper truth that could not be seen with the naked eye.

Through audiovisual editing, they learn to create new situations and projects. The audio-visual offers the possibility to handle more complex realities in time. The time and duration are key to the cognition of a complex and long-lasting, not instantaneous reality. If it is true that cinematographic time, in combination with the most advanced computer graphics representation of space, offers a radical updating in techniques of representation of space and time, the audiovisual narrative of space certainly has a greater range than the representation of the created spaces. It is able to intuitively correlate images and concepts, feelings and thoughts. It allows the various technical and constructive issues of architecture to be addressed and gives access to original critical and analytical processes. The instinctive-experiential knowledge grasps hold of reality and opposes the "what was known", framed as watertight "subjects" and "contents" that are transmitted through the deductive method in educational institutions.

The development of alternative project processes such as audiovisuals that can record the dynamic elements of reality such as time, movement, sound and light, constitute an intuitive more than rational learning. It involves a bodily and gestural learning in which the camera movements, its translation, panoramic views, zooms, games with the depth of the field, 'free camera' … they are all emotional impulses and corporal sensations. The capture of the sound and the music incorporated, seeks to adjust to the mood and the environments that are built, contributing to the structure and rhythm of the sequences of images and scenes. Finally the montage fits intuitively to narrative structures and objectives. The process of handling and mixing of all these elements is only possible through intuition rather than knowledge that we can teach our students.

The reason for being and the fundamental elements of architecture as a functional and artistic discipline, interact with the elements of the audiovisual montage whose main objective is the narration. The images which are situated at the most basic level of learning, lead up to the words and the narrative construction, to a new literacy of space and an initiation from a 'zero degree' of architecture.

2 Image-Movement

Learning from images has been the unusual method of Aby Warburg who created the Atlas Mnemosyne or Atlas of Memory, a series of panels that were montages of photos displayed forming sequences, not fixed but mobile and interchangeable according to the status of the research, and related according to the principle of "good neighbourliness". This system, we are now talking about the 'montage', was also used by Walter Benjamin in his work the *Pasagges*, generates new meanings linked to the chance meeting between "small private moments", senses outside the usual classifications, new knowledge genres, alternative models that open our eyes to unnoticed aspects of the world, to our own unconscious vision. It is a heuristic-creator method which gives us the suggestion to work with the montage as a tactic to boost creative-intuitive processes. These processes have the best adjustment to the current degree structure, the available time (brief) and the cinematographic technique as a more current resource.

Working with images rather than with concepts is therefore a more natural, more spontaneous, more intuitive way. Is this not the case of how children's literacy begins? If children gradually develop the ability to understand that the images have meaning and they therefore, enter into the world of conventions that, on the other hand, are necessary for learning to read, write and speak, they later learn that the images represent something more than just one thing. They then rid themselves of conventions and rush towards experimentation and creativity.

Images are not a universe that represent the world of a subject, but a universe of images themselves and for themselves; immanent images that do not depend on the human eye. Such images displayed by Bergson in *Matter and Memory* (2006) made up a kind of material universe in perpetual motion by the action and reaction of one upon the other before we can speak of "mental images". The concept of image is inseparable from the movement of matter, in such a way that, an equivalence between image, movement and matter is established. Such a conception of the world as a "material universe of moving images released from the consciousness as an open system of images in perpetual change, far from being the representation or copy of an external ontological reality on a plane of immanence, means that the subject itself belongs to this plane". It emerges as a "center of indeterminacy" as a "condensation of matter-image that allows the emergence of a plurality of vivid images from which one can understand the genesis of subjectivity" (Deleuze 1991, 15).

Inside Bergson's way of thinking we witness a genuine reconstruction of the concept of image. Bergson confers superiority of the image over the concept. The image evokes a content of thought in a more fluid, less abstract way than the concept form. The image is not originally something to be seen, that is perceived or thought about, but rather something moving, which is in perpetual motion independent of consciousness. All we have originally is a universe of images moving radically without a centre, axis nor reference; a material world of "universal variation", which escapes the understanding of intelligence (Deleuze 1991, 96).

Bergson's universe for Deleuze is like a big projector, an immense projection machine of luminous images that are spread everywhere, regardless of whether they appear to the eye or are reflected on a screen. Beyond what is set in our habits and conditioning of our perception and thought, the various operations with images are related to the different levels of analysis of reality. Because the reality is moving and changing, content of the architectural design therefore cannot be other than the images, as they are also matter for the cinema. We would say that we project with images. The virtually installed architectural project becomes the future, it is the image or images of a future.

3 The Images and the Words

If the letters and the words for the children are at first images that will be eventually recognized together as pattern representing part of a story, for us the narrative construction is still one of the main patterns of learning. The construction of a story begins by speaking about what one is doing. Doing and then reflecting on what has been done, becomes fundamental to this educational tactic that consists of going from the action to the concept, from the unconscious, impulsive, intuitive, creative act to the conscious construction of concepts.

If the drawing is a significant practice of motor skills, it is the means for the coordination of eye and hand, the subordination of the hand to the eye it is one of the dominant practices in our Western culture. The domination of view over the other senses, has dire consequences as Pallasmaa (2014) and others authors, who reflect on architectural space, have denounced. So here we intend to undo this conditioning of the eye and intelligence. Instinctive body learning, triggering the hand of intelligence and the liberation of the body constitute much more intense and practical experiences.

The generation of images that are alike, hand drawings or digital renderings, fixed photographic and moving images (film), interest us from the point of view of Didi-Huberman (2012) as corporal and unconscious gestures that produce these images and the kind of knowledge they provide.

We are also interested in the images when they come into play with the words for narrative construction. The audiovisual is a complex narrative form. All the time-space elements take part: images, words, sounds, light, time, duration and ideas … A good description of what one sees and hears, of what happens in our environment and what we understand constitutes a good basis for learning and for doing a simple audiovisual. This type of configuration involves the most complex and specific connections of sets of forms and images. These connections do not exactly arise spontaneously but they occur because the learners are problem solvers. Their imagination rather than their personal vocabulary, which is limited initially, slowly grows with the support of the teacher and other students. The sense of commitment and pleasure must be present and can achieve a high level with the support of an attentive teacher.

Finding the words to say about what one is doing and predict what one will do, means that they acquire the capacity to solve problems and to do projects. Spoken language is a significant base that allows them to take the hard work of thinking, doing and speaking more independently. Over time words can bring them to a deeper exploration of the images than that of their own creative efforts. The power of words to generate emotions and images, leads them to a new threshold of expression. Words are now images that allow the expression of ideas, feelings and thoughts. They evoke images that go beyond the forms. They are now mental images.

The architecture and audiovisual approach share objectives and strategies in the development of an idea. The architectural project is practically equivalent to the storyboard. Space and time are the two constituent elements of architecture and the audiovisual sector. Space and time are the same dimension. The study of light bears the same relationship with the elements of architecture and cinematographic space. The plane and the composition concern both disciplines. The cinematographic time and the architectural time are the time and duration of a narration. Between the architectural project and the film there is a structure that generates an arc of transformation of reality, a verisimilitude which works in the same way trying to empathize with people.

4 The Workshop

During the last academic year we developed three audiovisual exercises that we have alternated with other more classical exercises of graphic expression. These correspond to three levels of learning. The first was held at the end of the first semester when the students had already acquired certain graphic skills and the other two in the second half of the second semester. The first exercise was individual and the other two were performed in groups of two and three students respectively. The first two exercises were performed using Moviemaker and the last with Adobe Premiere.

In the first exercise we tried to rebuild a spatial sensation simulating movement in the interior of an artifact built by the students through the sequence of drawings and photographs of the artifact, incorporating light as a fundamental element in the construction of the space. The aim of the exercise was the understanding of architecture as matter and light, as a sensitive enveloping atmosphere rather than a geometric abstract space that can be represented through conventional drawing (Fig. 1).

The second exercise involved the interpretation of a text as an architectural space. It was to design the scenery of a theatre play and to make a presentation trailer of the work with a video of one to two minutes. The aim of this exercise was on the one hand, the reference to architectural functionality addressing the body, movement, ergonomics and the feasibility of the proposal with respect to the construction and materials and, on the other hand, the capacity of the conceived work to create atmospheres with the light, the ideas and the emotions of the characters induced by the text (Fig. 2).

Fig. 1 Stills from the first audiovisual exercise that seek to describe a process of understanding the configuration of architectural space. Student: Elisa Pascual Olivera

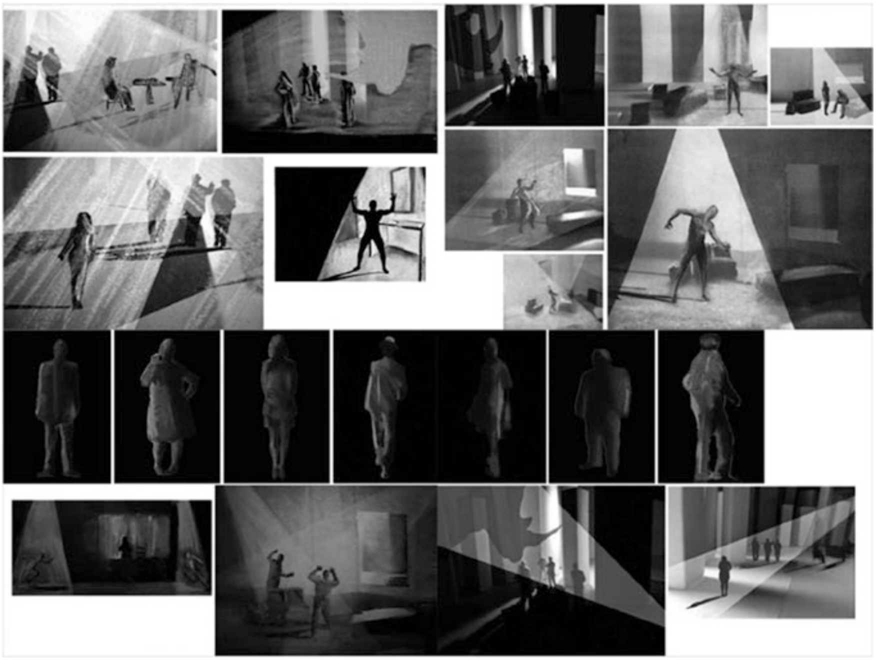

Fig. 2 Stills from the second audiovisual exercise on *Rhinoceros*, a play by Eugène Ionesco. Students: Alvaro Brotons Ilarri, Laura Moreno Rosell, Bethlehem Zazu Vives

In the third exercise, students tried to modify a particular urban space with few resources and record the action through a video. What was proposed was a direct transformation of reality with a poetic action or a performance or an ephemeral installation or just recording a different and strange look that would provide a new and transformed reading of reality (Fig. 3).

The three exercises were progressive and complementary. In the first we tried to exercise the constructive-spatial understanding of architecture. Through the montage of a series of drawings and photographs of a model, movement was simulated through an interior space that previous students had built, lit and placed a human figure as a measure and indicator of the scale. This experience helped to conceive, in the second exercise, a scenographic space where the construction elements and light were subordinated to the action of the characters and their emotions. So the architecture ceased to be understood as mere construction and was now understood as a space for action where humans carry out their wishes and dreams. Once the staging of a theatrical play was addressed, in the third exercise we tried to read the urban scene with its protagonists, the people, and for each to create their own screenplay; to make a story by moving images, sounds and words recording a dynamic and changing reality. The process was similar: instead of reading the text they were now recording abundant images, moving images, sounds and voices and interpreting them; imagining what could be done, what elements could be introduced to modify a

Fig. 3 Storyboard and stills from the third audiovisual exercise on an urban action. Students: Jaime Hernández Gómez and Carlos Escobero Villarrubia

given situation, an urban scene. The 'project' here was understood as any imaginative practice (generator of images).

The objectives pursued in this last exercise were those of a first approach to intervene within the complexity of the urban scale, taking into account the interaction of multiple elements both material and imaginary, sensitive-experiential understanding of the existential environment and an active chrono-spatial relationship with the environment. Students had to experience the architectural intervention as a transformation of human social fabric, as an act of communication and coexistence with others. The situationism and the new trends of creation of public spaces for alternative uses, ephemeral installations, recreational areas, urban art, land art, performance, body art, Arte Povera, video art and artists such as Beuys, Kounellis, Basurama and other contemporary groups, have been taken as references for this work. Some notions of filmmaking through examples have also been given as well as the storyboard and the montage.

Learning from the images effectively, now becomes a process that has many similarities with that mysterious production of speech before knowing the rules and theory. The discursive structure of the images through cinematographic montage, find an operational sense for the subject who sees such images, occurring practically before any purpose of representing reality, let alone build it. The images themselves have more power as imaginary builders than faithful representatives of reality.

5 By Way of Conclusion: The Experiential-Intuitive Education Alternative to Analytic-Deductive Method as Innovation

In opposition to the Platonic idea of the image as a representation of reality, the images are all unstable forms practiced to imagine, remember and record looks. Didi-Huberman (2012) raised the notion of "dialectical images" as an answer to the question “how to make from the images a matter of knowledge and learning.” Faced with the “image-icon”, the “dialectical images”—that were also discovered in the Atlas Mnemosyne by Aby Warburg (Didi-Huberman 2009)—are the epistemological assumption of montage and the appeal to the “unconscious memory”. It was also Benjamin’s literary method. From our habits—we are but something made up from the customs of a world that precedes us—and our knowledge—that is made up of contractions of images-matter—we jump however into the unknown seeking new ways to experience, to feel, to think, to live and to create. It is also a new way of generating thought to the limit of experience and in relation to other disciplines. What is found in every creative act is an alteration of space and time formed by our empirical habits and thereby also an alteration of subjective images.

The idea, which underlies the montage, is that of how images interact with each other and with the words from a creative point of view, the end result however obeys to a series of rules that are unknown, but that are revealed and codified to us. To act and then to think about the making and the facts is the basis of our philosophy. What we are searching for, is to discover words that relate closer to the action than the reflection. The configurations achieved are stimuli for reasoning, not only about the apparent realities but also supersensible ones. Our eyes see what is outside of us but not enough to decode the overwhelming reality. What we want, therefore, it is to learn to look in depth. Through the camera that sees more than we do, we practice staring profoundly and gaze.

Through audiovisual we experience “time” versus “space” which usually focuses all attention on the architectural project. Time and perception of change are not accessible to the intelligence that records only static moments. Intelligence, according to Bergson (2006, 261–273), captures states of reality at rest that we translate as concepts, creating the illusion that we know what is real, that is to say, objects and elements in their temporary evolution, their duration. If matter-image does not cease to change continuously, intelligence only retains a stable vision that is modeled on a perceptual level as a “distorting image.”

Duration is however the ambit of the difference and of the heterogeneity. According to Bergson, reality is related to two orders: one homogeneous, characterized by the dominance of the spatial dimension as a quantitative and multiple order; the other, heterogeneous, characterized by a time experience as duration achieved by the perception of the qualities and the quantitative indeterminacy. Bergson relates these two dimensions of reality with two aspects of conscious life: one superficial in direct contact with external reality and another deep, where the continuous flow and diversity of the duration of our consciousness happens. For Bergson, the “perception” provides “space” while the “action” disposes “time”. The two worlds are well established: the space as stable and necessary, as external matter; and time: the dynamic and spontaneous, life, inner experience establishing the reality known only from within, the immediate and intuitive touch.

Intuition avoids “false problems” created by a thought dominated by intelligence and limited to recognize its own illusory projections. Intuition pushes us to achieve the real conditions that originate it, i.e., allows us access to the experience in its own genesis and to the intensive differences that articulate reality. The images that allow us to access real knowledge in a more effective way of understanding reality than concepts are also memory-images because the "perception" is "memory". It is totally impregnated with memory-images that completes it as well as interprets it and that requires a "call" at present to get updated.

Learning from moving images involves capturing the "differences", changes, transformations before they are distorted and nullified by the natural perception and human intelligence. This process occurs according to Deleuze (1991, 96–98) as follows: the movement of the images becomes "image perception" by the senses and the nerves that lead the image to the brain where it becomes "image-affection" returning along the nerves to the muscle and becoming "image-action". The image then becomes individual and subjective deploying its range of perceptions, affections and actions which applies both to the human subject and to the cinematographic image.

The innovative base of this pedagogy is to recognize the conceptual frailty, the weakness of the rational-deductive methods and to be open to the experience and in particular to the experience of space. By this method we aim to release the subjectivity leading it to a world populated by images. This world of images is preceding the subject which is formed by this world. It is a pedagogy founded on the intuitive act, the intuitive processes that generate habits of life, liberty and reflection. Its is based on action rather than reflection before action. Reflection follows after the action and it is about key issues of the architectural discipline, such as matter, time, body and movement, which manifest themselves in distintive forms in our representations. The basic theme of architecture is the time and the duration, whose understanding is only accessible by intuition as non-conceptual understanding. That is "the immediate data of consciousness" (Bergson 1999) which makes us understand the act of knowing as coinciding with the act that engenders reality.

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Experimentation with Colour in Architectural Spaces

Juan Serra Lluch, Ana Torres Barchino, Irene de la Torre Fornés and Ángela García Codoñer

Abstract Even if the false myth of white in modernity is already over, we have a chromatic tradition to some extent broken and which needs to be rebuilt, or better re-experienced. In the Master's subject "Color and Design of Spaces", a teaching is developed seeking for a critical understanding of our visual culture and a creative experimentation with colour in architecture. We analyze in depth the strategic ability of colour to support a particular architectural intention together with its cultural and semantic connotations. Secondly, we experience the chromatic possibilities rendered by new building materials, lighting technologies and computer design software.

Keywords Colour · Interior architecture · Design

1 A Two-Fold Approach to Colour in Architecture: Review and Experimentation

Colour has always been an essential visual attribute in the configuration of interior architectural spaces. Historiographers of modernity paid no particular attention to it, and even went so far as to accuse it of perilous flights of fancy, but the fact remains that the architects of modernity used colour in a very deliberate manner, at a time when psychology was striving to get to grips with the mechanisms of the perception

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of shape. So although the myth of the colour white in modernity has been overcome (Serra 2010), we find ourselves before a somewhat discontinuous chromatic tradition that needs to be reconstructed, or better still re-experimented.

In this context, somewhat bereft of prominent references, the question of colour has made a resounding and at times spectacular return to contemporary architecture. As a result, as part of the "Colour and Design of Spaces" course, part of the "University Master's in Advanced Architecture, Landscape, Town Planning and Design" (MAAPUD), we advocate a curriculum that facilitates a creative experimentation with colour, supplemented by a discourse that takes into account our visual culture.

Students firstly carry out a critical literature review of colour in architecture, with an in depth analysis of the work of an architect or artist of interest with which to collaborate. We begin with the standard insights into the visual perception of shape, we analyze the strategic capacity of colour to bolster a specific architectural purpose and we evaluate the resulting semantic and cultural connotations. An attempt is made to compensate for this lack of concern for colour in traditional architectural critics that brings with it a lack of criteria and arguments to allow us to carry out our own architectural considerations.

Secondly, we experiment with the visual capacity of colour in contemporary architecture: the plethora of chromatic possibilities of new building materials, lighting techniques and computer design software have managed to exponentially increase the number of interior finishes. This all culminates with a colour project for a constructed space, experimenting with traditional and innovative materials.

The outcomes vary, from a simple, unadorned architecture that is in keeping with the self-restraint of "minimalism", to more stimulating, versatile and ambiguous colours through the use of digital technology. In any case, the aim is to achieve a colour scheme that is consistent with the architectural concept that reflects the contemporary moment.[1]

2 Literature Review of Architecture and Colour

"I will never understand architects! They are always afraid of employing bold colours side by side". It is of particular note that this comment is uttered by an architect, but even more so when we discover that they are the words of Loos (2011, 63), who has been unfairly blamed for the criminalization of colour and for paving the road for the predominant use of white in later modern architecture. And it is not an isolated example of this apparent contradiction by a number of architects, from the early part of the 20th century all the way up to the present day. How else would you explain the words of Sir Foster (2007, 224), an architect with an

[1]This paper is just one of the activities linked to the R&D project "New methodologies to evaluate the visual integration of architecture that has an impact on the urban landscape" financed through funding from the *Valencia Regional Government's Department of Education, Culture and Sport*.

apparent disinterest in the subject of colour, when he assures us that “colour has been a strategic component” in his work. And that “in each case, adding colour enables one to hone one’s thoughts”. Effectively, pondering colour may well help to fine-tune the architectural intent or purpose, in the case of Foster, through his collaboration with other artists such as Per Arnoldi. Of course, joint collaboration between architect and artist is not only fruitful but is at times essential to the aesthetics of architecture, as is the case with other partnership collaborations such as Michael Craig Martin or Adrian Schiess for Herzog and de Meuron.

It is therefore no surprise when carrying out a review of colour in architecture that there are two potential fallacies. The first consists of considering colour from an exclusively sentimental perspective, primarily catering to connotations that go beyond perception. An approach, which, in a best case scenario, limits itself to a semiotic interpretation of colour, and in the worst case, explains colour in terms of pseudoscientific or even esoteric convictions, about moods and their therapeutic potential. A marshy path to go down (O’Connor 2011) and somewhat short lived, to our understanding. The second fallacy is that of architects who articulate an artificial discourse regarding colour in their works, distancing themselves from the architecture that is constructed, normally in order to dramatise their detachment towards colour. Unfortunately, there are those who consider that colour should not be part of any architectural discourse or should be invisible, even when the work in question stands out for its colour scheme.[2] Some architects renowned for the use of colour in their work are aggrieved when they are asked about colour (Alsop 2010), as if it were of little relevance, despite knowing that colour carries a certain weight in their designs, together with other architectural variables, albeit with an exclusively two-dimensional assessment of the phenomena of contrast and harmony. This is very different however if the emphasis is on the light, something we architects love to talk about, as light is the source of architectural volume and space in a game we know only too well, that is shrewd and splendid. A wonderful paradox that makes us forget that colour is also “son of the light”[3] when it fertilizes the space, once again paraphrasing Le Corbusier (1997 [1931], 1:113), or as indicated by Poelzig (1991: 16) “colour, when compared to shape, is the primary factor”.

We are specifically interested in an approach to colour in architecture that is far removed from the sentimentalism and somewhat artificial attitudes, that caters to the material reality of architecture constructed in a more systematic manner, and which enables us to study the links between colour and the formal concerns of any architectural project. This is, to our way of thinking, the key component of any

[2]It is of particular note that when Luis Barragán accepted the Pritzker Prize, he only mentioned colour twice during his speech: in the first, he referred to the inspiration he found in the “colour-filled streets” of the Mexican province, and “its white-washed walls”, while the second was to warn that an “indiscriminate colour palette” might conceivably chase away the serenity of the architecture (Barragán 1980).

[3]“The search for space, for light, for joy, for strength, for serenity, invites us to call for colour, son of the light” (Le Corbusier 1931, 1:113).

literature review of colour and architecture. Bofill and Bofill (1976, 49) captures it perfectly when he states that "colour should be used to define the internal laws of the architectural form of the building, making them visible and aesthetic".

Naturally, from a colour perspective there are other cultural, symbolic, semantic and even emotional elements that abound, but as architects, we are mainly interested in those that are primarily design based. We attend to architecture that employs colour as a *strategic* component in arranging the forms and spaces, as would be the case with any other design variable that are orchestrated to achieve a single concept: no more, no less.

So the students taking the course on colour taught at the Department of Graphic Expression in Architecture (DEGA) understand that the use of colour in the works of a number of modern and contemporary architects could be understood to be a component that is perfectly trained to their thoughts and their approach to conceive architecture, and that any bias expressed by considering colour as a purely cosmetic and epithelial matter is nothing more than a fallacy. Quite the reverse, a detailed analysis of the works of internationally renowned architects such as Neutelings Riedijk, Bert Van Berkel, Sauerbruch Hutton, AB Rogers, OMA, and Spanish architects such as Selgas Cano, Langarita-Navarro and MGM, enable us to acknowledge the ties that colour has with the design concerns of each and every one of them (Figs. 1, 2).

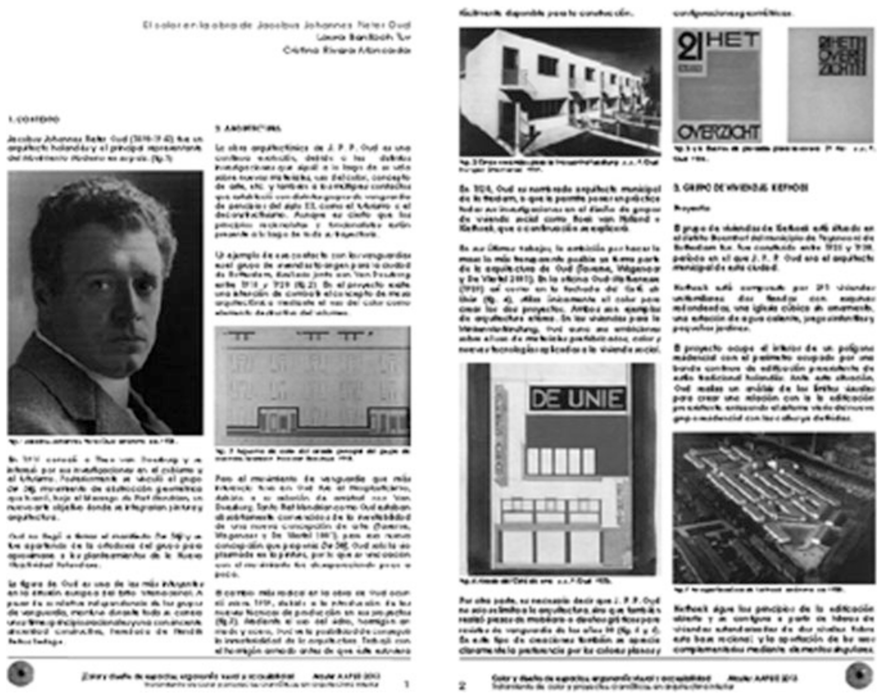

Fig. 1 Colour analysis in the architecture of Johannes Pieter Oud. Work by students Laura Benlloch Tur and Cristina Rivera Moncada

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"Actuamos como anfitriones victorianos: hemos montado una fiesta, observamos que hay alguien aburrido, a punto de irse, e intentamos acercarle a otro amigo, que creemos que puede activar esa situación"

Fig. 2 Colour analysis in the architecture of Langarita-Navarro. Work by student Silvia Valero Rodríguez

Colour employed not as an end as such, but rather as a *strategic component* (Serra 2013), allows us to play with the visual properties of the architectural form so that the architecture mimics/or stands out against the urban landscape,[4] to integrate/disengage its components, to describe aspects that relate to the function and the composition of form, to link to the local culture within a specific context, or to append an additional artistic value to the architecture, etc.

3 Experimentation with the Visual Possibilities of Colour in Architecture

During the different editions of the AAPUD Master's Programme, students were challenged to resolve a real case scenario, to improve the quality of a chosen architectural space. Ultimately, the aim is for the colour intervention to effectively respond to the functional, compositional, aesthetic, cultural and any other aspects of the design of the space, the guiding principle being the purpose for which it is used.

[4]Colour plays an essential role in the visual integration of architecture that has an impact on its surroundings, both natural and urban, a topic that we are currently researching at the UPV Colour Research Group.

Fig. 3 Colour project designs by students in Calle Músico Peydró as part of the "Valencia Despierta" (Valencia Awake) event

During the 2013/14 academic year, the task involved an urban space in the historic centre of Valencia that as part of the "Valencia Despierta" (Valencia Awake) event, organized by the Association of Trade and Commerce for the Historic Centre of Valencia in collaboration with Valencia City Hall. In addition to the urban space, a series of small retail businesses opened their doors to enable the young artists to implement their innovative projects inside too. Among the proposals submitted by students, the ones that stood out were entered into a contest that involved well-known professionals, local authorities as well as representatives from the Association of Trade and Commerce. So, during the Christmas season, a series of streets and local retail stores located near the Central market were transformed using colour to reinvigorate their image, inviting passers-by to step inside.[5] Furthermore, the project outcomes from this initiative were on exhibit at the Valencia Region Art and Crafts Centre from 29/05/2014 to 04/07/2014 (Fig. 3).

During the 2014/15 academic year, the programme focused on the interior of the Inter-University Research Institute of Human Centred Technology (LabHuman), located in the Polytechnic City of Innovation (CPI) at the Polytechnic University of Valencia (UPV). These laboratories are home to research projects linked to the collection of the emotional responses of users, as well as improvements to ensure that technology naturally and seamlessly integrates itself into our day-to-day activities (Fig. 4).

At the entranceway to the laboratories of LabHuman, there was an area used as a reception area and for circulating that appeared excessively innocuous and needed to be tackled to reflect the innovation concerns espoused by the centre. Once again, the work was carried out as part of a contest, with an exhibition highlighting the

[5]A video of the results of the work by students can be seen at the following link: https://youtu.be/FL8Tv2gkvoI.

Fig. 4 Exhibition poster for the "LabHuman: Colour and Interior Architecture" Prize with a picture of the winning project by students Darío Perpiñá Girona and Adrián Tarrazó Ribes

projects submitted[6] and the subsequent selection of winning entries by a panel of experts.

The winning students experimented with how colour can be used to shorten and lengthen one's perception of the length of a space, experimenting with the geometric pattern of uneven dimensions based on their distance from the observer, and applying their knowledge of colour kinetics, stemming from the experiments of

[6]"Colour and Interior Architecture Award: Exhibition of entries submitted". 22/09/2015 to 06/10/2015, UPV School of Architecture.

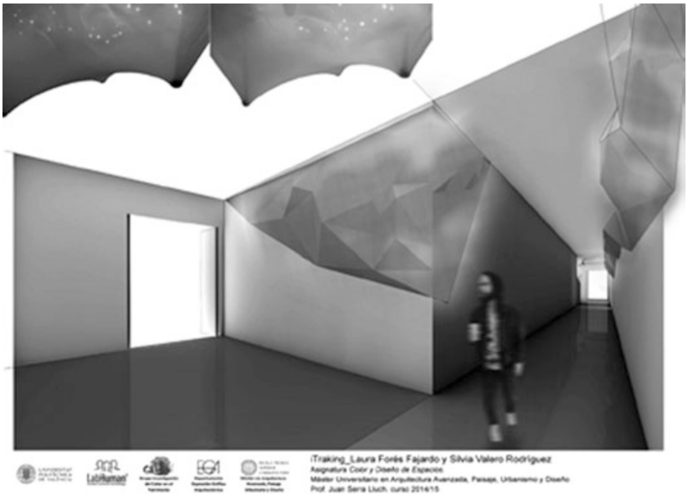

Fig. 5 Runner-up for the "LabHuman: colour and interior architecture" prize by students Laura Forés Fajardo and Silvia Valero Rodríguez

Joseph Albers in the 1960s.[7] In addition to the fundamentals of the perception of colour, digital motion capture technologies were used, as well as LED lighting systems that allowed us to change colours, to give a boost to the material solutions, enabling them to achieve *chromatic versatility* that is so unique to our contemporary visual culture (Fig. 5).

4 Knowledge Transfer—From Review to Experimentation

Perhaps one of the most interesting aspects of the two-fold approach (review and experimentation) to the source curriculum is the resulting two-fold knowledge transfer. On the one hand, a critical analysis of the role of colour in contemporary architecture to expand upon the repertoire of potential visual possibilities of an architect, while at the same time, stimulating activity. Furthermore, experimentation is an effective way to activate creativity and enables one to bring into play the ability to judge and self-criticise the colour decisions made while developing and architectural project. In short, it manages to integrate the colour variable into the dialectical discursive-creative variable that is involved in all architectural creation (Fig. 6).

[7]A new edition of this definitive book de Joseph Albers "The interaction of colour" (1963) was recently published, this time in the form of an electronic app that enables one to browse through the original exercises of the master of colour (Taboada 2015).

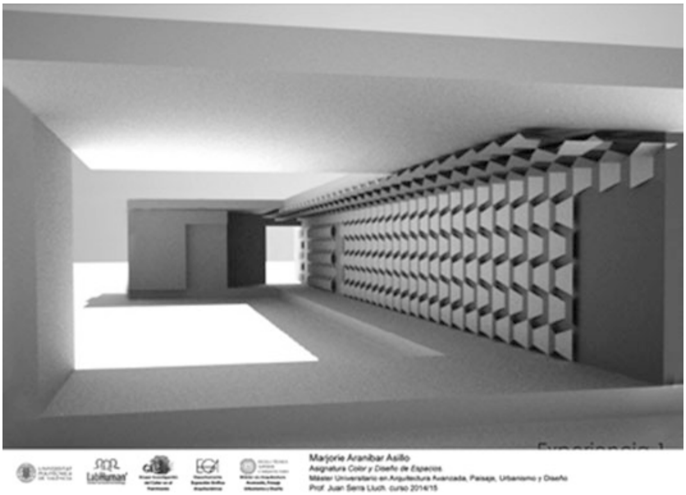

Fig. 6 Second runner-up for the “LabHuman: colour and interior architecture” prize by student Marjorie Aranibar Asillo

In this way, and by way of an example quoting certain cases, students put into practice the colour resources that enable them to meddle with the functional organization of architectural spaces, with the orientation of users and how they circulate, and with the characterization of the functional purpose, etc., based on a literature review about work by Norman Foster (together with Per Arnoldi), Richard Rogers and Renzo Piano.

Sometimes, the works involved the dialectic relationship that architecture establishes with its context, from mimicry to individuality, based on solutions employed by architects such as MVRDV, Neutelings Riedijk, Jean Nouvel, etc.

At other times, students implemented in their projects a range of subtle colours where aspects of contrast between light and shade dominate the hues and colour saturation, together with specific architectures such as those by Selgas Cano, RCR, Peter Zumptor, etc.

The possibilities for dynamism, space kinetics, anamorphism and optical effect are put into practice taking the works of artists with ties to architecture and with artistic movements such as Op Art, Kinetic Art, etc.: Felice Varini, Olafur Eliasson, Carlos Cruz Díez, Boa Mistura, etc. as references (Fig. 7).

In short, the list of chromatic resources assimilated during the analysis and taken as effective vehicles to achieve specific architectural purpose built around the architectural design, support the personal development of a specific intervention that has its own restrains which are answered by resorting to the visual aspects of colour and their materiality (Fig. 8).

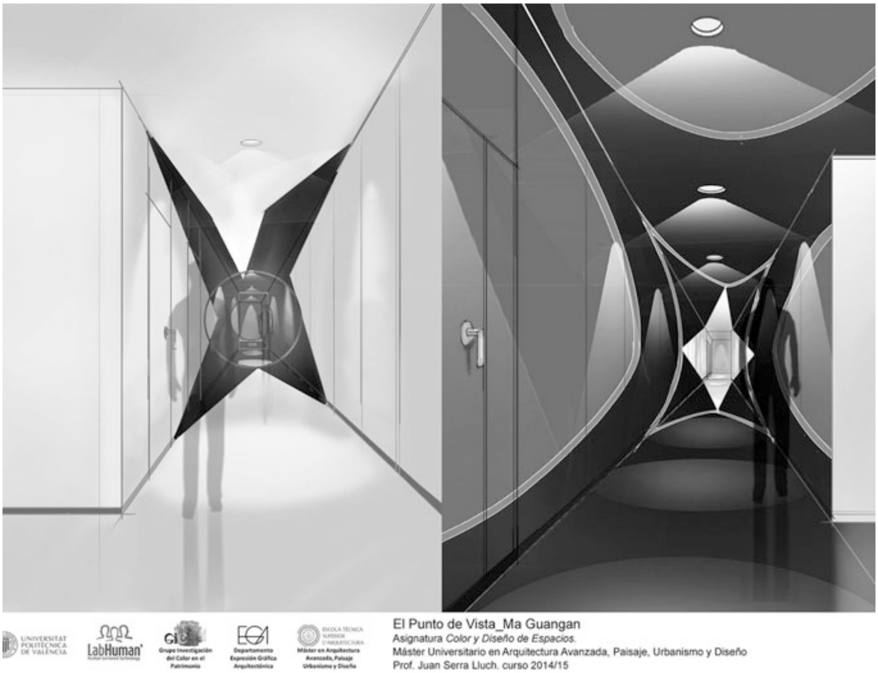

Fig. 7 Entry for the "LabHuman: colour and interior architecture prize" by student Ma Guagan

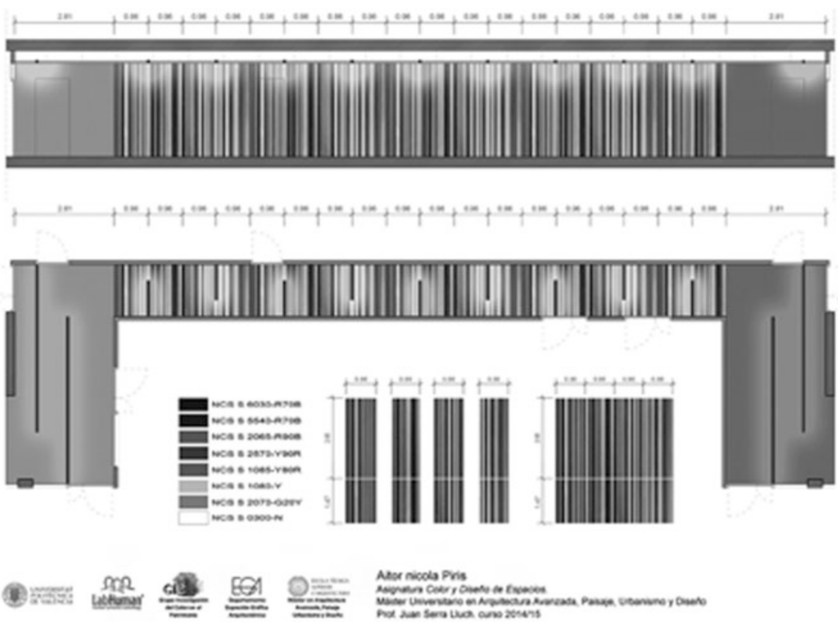

Fig. 8 Entry for the "LabHuman: Colour and Interior Architecture" prize by student Aitor Nicola Piris

5 The Teaching of Colour in Schools of Architecture: Essential Knowledge

The lack of training in colour that is included in the teaching curriculum of architects continues to the present day and needs to be revised. One need only remind ourselves of the importance that colour had in the early years of the Bauhaus, with the involvement of some of the most influential painters and colour theorists in 20th century architecture such as Kandinsky, Klee, Itten and his disciple Albers, also acknowledged for his later work at the University of Yale.

The EGA Department in Valencia has amassed a wealth of experience in the teaching of colour both over the past 15 years in both its degree and Master's courses, and has been able to ascertain its utility in the all-around education of a professional profile which, today more than ever, is unable to avoid the aspects of colour in a society that is over-stimulated by a multitude of images. The assessments made by students who have passed through our classrooms attest to this and coincide with the opinions expressed by other students from foreign universities where specific courses on colour and architecture are taught (Janssen and Mikellides 1998).

Of particular mention is the work being carried out by certain researchers and professors as part of the activities of the *Study Group on Colour Education,* part of the *International Colour Association* (AIC), in which the UPV Colour Research Group is also a member. The working group, which has been operational since 1978, exchanges experiences and expertise in the field of the teaching of colour by professors from different countries, with a scope that reached far beyond Europe.

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The Use of the e-Portfolio as a Graphical Tool of the Architecture

Carmen Escoda Pastor

Abstract In the new study plan of the ETSAB a implementation experience has been done with the introduction of e-portfolio, in the Final Degree Work, as an educational resource that resource that boast the autonomous work and the interaction of the studies additionally it is a technique for collection and selection of the most significant works made by the student throughout the degree. It is intended that, above all, through the graphical representation, be able to explain their competence in the various subjects, as well as increase their autonomy, inviting him to reflect on the learning process of the architecture and stimulating their critical capacity.

Keywords e-portfolio · Graphical representation · Architecture

1 Introduction

The portfolio, or "folder of learning" is meant as a technique for compiling and repertoire of skills that enable the author to the successful development of their profession. This communication is based on personal experience, which is to be assessed by the student's portfolio tool. Compared to classical learning, this type of interactive method, aims to establish the prioritization of objectives and competencies of a student who finishes the degree in Architecture and evaluates whether it is able to register in the Qualifying Master.

The e-portfolio is therefore an academic document containing the summary of the work performed and extracurricular experiences during a very important period in its development and showing how to understand and interpret the architecture of each student. Worked with different softwares, stimulates the autonomy and creativity of the students, showing the learning process and reflections on evolution.

During the week from 25 to 29 May 2015, the conference of educational innovation in architecture JIDA'15 (III workshop on educational innovation in

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architecture, coordinated by Professor Jordi Franquesa), took place in the School of Architecture of Barcelona, in which he discussed the graphic elaboration of a good portfolio and *curriculum*.

"In particular, this third edition is based on the debate between two important educational environments: the academic and the professional one. The link between learning methodologies and the consolidation process of the knowledge on the discipline that the student is taking in throughout their studies must be contrasted with the professional practice of our architects, the job market and the socio-economic context in which our society is involved in. That is why the purpose of this workshop aims to focus not only on the discussion of educational methodologies, but especially in its effectiveness to ensure a good traineeship which will allow the future architect to adequately address the challenges posed by society." (Franquesa 2005).

The objective of this experiment is to improve the achievement of learning expected for the level of training, according to the curriculum of the degree, based on the promotion and development of self-criticism of students, with the intention to strength and enhance their level of autonomy and projective in the discipline.

On the other hand it is essential that students learn from other websites of architects. In the actuality it's necessary that the architect has his portfolio on the web to show their work and skills in the area of architecture. One example of prestigious architects who have created a very clever and well structured web is the BIG group. On its website, BIG organizes projects based on a series of icons that ordered chronologically, alphabetically, by type program or by scale and by state for easy access to the works. Each project has been reduced to an icon formed by a pictogram that captures the essence of it, on a colored background indicating the function of the building (Fig. 1).

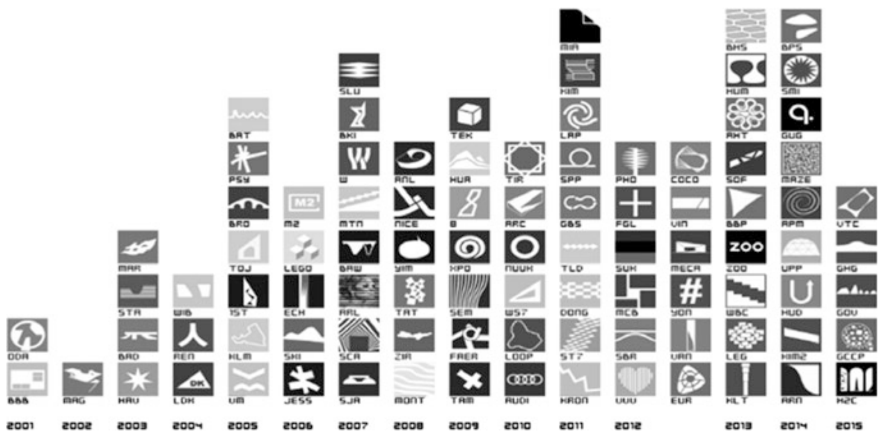

Fig. 1 Website BIG group. Each project is represented by a pictogram

2 The Process

The process makes architecture, moreover, didactic substance. In the past, the architecture was the occasion for pleasure or response to the need; that is, aesthetic delight which was a mental operation or protection and refuge against adversity, which made us see, in turn, its instrumental condition. Now the architectural experience has become didactic material. The process teaches how. The architecture as process is the architecture of the schools, places where we learn to 'how-to do'.

In the develop of portfolio it is implicit how it has conducted this learning process. The composition and format is completely free. The student structures his document into several blocks, intentionally setting the order to go. Menus are deployable and allow several options. In the portfolio structure is not only valorated the learning process, but also the design, creativity, graphic composition, capacity of synthesis, the capacity for reflection and self-criticism and the presentation and exhibition of the same is valued. It is complemented by a research project, which is to develop a topic that is of interest of the student in any of the subjects.

"The use of the portfolio arises in the world of art and in particular of the architecture and design, we can say that the portfolio as a technique, arises from the need to demonstrate professional skills in the labor market" (Barragan 2005).

There are different types of portfolio, the professional and the academic. In the first curriculum, works, publications, are exposed in an objective manner and addressed to the general public. In the academic however, there is a work of reflection and self-criticism that the student must do and that is going to be evaluated by a court academic. The student explains the evolution of its work, especially from the point of view of transversality. When you really appreciate this synthesis and interconnection between different subjects and concepts is in the last work of the degree. In the graphical representation apply, intentionally and selectively, differents techniques ranging from the hand drawing and models to infographics techniques more sophisticated. It is essential the interconnection and interrelationship between the different graphical tools that are used in this process of learning (Fig. 2).

The portfolio is not only the reflection about the discipline and the collection of the degree work, it is also a collection of extracurricular activities. The discipline of architecture has this multidisciplinary character that has been to enhance during this process of how do architecture and that enable different perspectives about the same.

"It is to make this collection that we realize our evolution, comparing our projects and watching them one next to the other. It is a moment to pause and look back at our learning, to know where we come from and where we need to continue" (Laura Sanchez 2015).

The work is supervised by a professor at the School of Architecture of Barcelona. We will rely to explain the structure and development of e-portfolio in the work presented by five students: Anna Castellà, Diana Marinez, Irene Rodríguez, Laura Sánchez and Lorena Hernandez, including the most representative images and text of each e-portfolio.

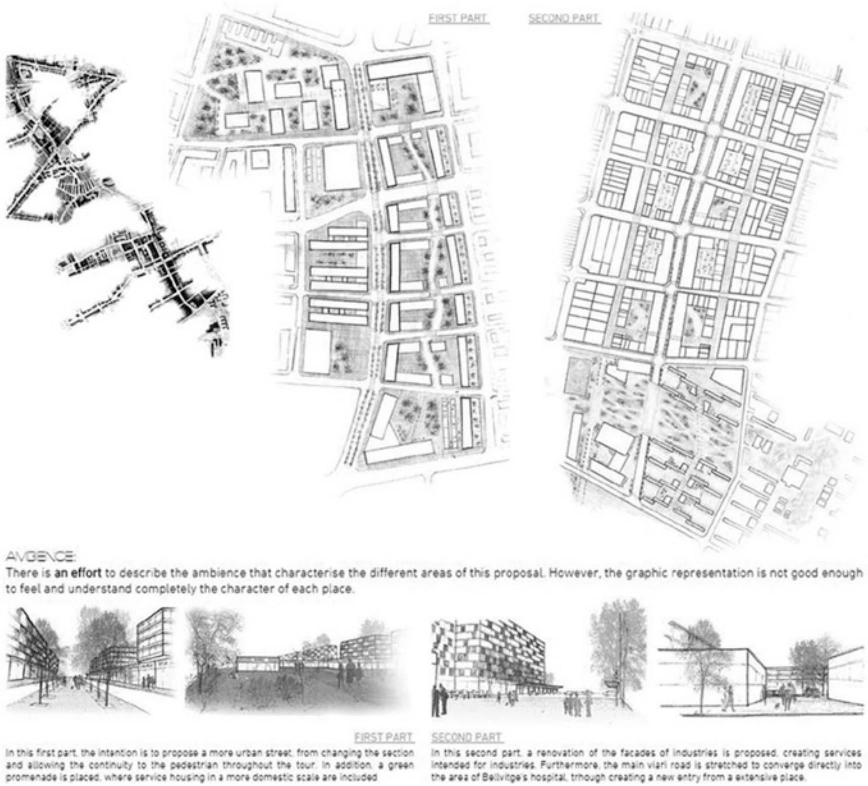

Fig. 2 Diana Martinez. The graphical representation in the urban planning area

3 Portfolio Structure

The estructure of the e-portfolio has to be adapted to the subject or activity. For the preparation of these e-portfolio is essential to define the goals and objectives that are identified as essential to achieve a good result. In our context, the e-portfolio is an interactive method of teaching-learning and to assess the contributions of the different types of production by students, through which you can judge their abilities in the process of design, in the process of creating and development that involves data collection, organization, re-organization and presentation.

In the Final Degree Work, the e-portfolio is structured by basics deployables blocks, designed from a templates WIX software: presentation, discipline, transversality, subjects and their interaction, personal contribution to the knowledge of the architecture, extracurricular activities, research work and a summary, through a reasoned narrative of the learning process, made from different languages and subjects and linked to an extra-academic training.

This allows students to reflect on the learning process on the discipline and the study of the architecture and intrinsically its transverse component.

The student Anna Castellà, structure the portfolio in several deployables blocks: presentation, architecture, materials, contribution to knowledge and summary. The illustrations that she selected for the main page are some representations in diedric, such as siting plans with thrown shadows, which correspond to different work of the subject of projects (Fig. 3).

"Looking with perspective these five years of degree, we can see that the architectural studies go beyond a simple acquisition of technical and aesthetic knowledge of the construction and its history. The discipline of architecture helps to better understand the society, the relationship of the inhabitants with the city, solves needs and problems adapting to context… From my point of view, I understand that an important part of the role of the architect is at the service of society, making an architecture rooted to the place, constructively sincere, sustainable architecture and respectful with the environment" (Anna Castellà 2015).

The student Diana Martinez organizes the main page in 18 deployable folders represented by the images that she considers most representative of their works. Each of the sections are accompanied by written re-flections (Fig. 4).

"In this e-Portfolio I do not limit myself to present only a careful synthesis of my teaching material and the work carried out throughout the career, but also I include reflections on the process of learning. I also expose personal and professional experiences that have provided me a greater knowledge of the discipline of architecture.

The aim of this portal is to narrate the personal learning process developed from previous knowledge and complemented by my own teaching, personal and

Fig. 3 e-portfolio page of Anna Castellà. The main blocks are deployable

Fig. 4 Organization of the collection of activities presented at the e-portfolio of Diana Martinez

professional experience. For this reason, the e-Portfolio lets show everything learned over the years, providing an opportunity to reflect on discipline and learning process" (Diana Martinez 2015).

4 Cross-Learning

It is essential to recognize the importance of mainstreaming in the learning process and in the planning of the profession of architect process. The continuous relationship between concepts, synergies, contextual, cultural and social aspects, is a constant in any architectural project. This gives the project this interdisciplinary character that is reflected in the program of the subjects, made up of various subjects that are interrelated in the project. Inconceivable is a project with no construction, no drawing, no facilities, the architect is the result of an accumulation of knowledge and variables to take into account there are many and differents.

Therefore, the critical view of the student about the transversality of the discipline is interesting in the e-portfolio:

> I have divided the degree into three large blocks. The first block, the approach to architecture (first and second year). Since the object is to understand space, the importance of the proportions of the light … It is also the first approach to the structural logic. The second block, bases, (includes the third and fourth course) is the period in which I learned technical knowledge and project management skills necessary to begin to project housing and equipment. This is one of the most important career because I learned all the basic tools to project. It may be that in this period is missing a bit of coordination between subjects. For example, in the course of construction, the constructive details of last years course project were designed. Why are not designed the project which is studying simultaneously? This would enrich the project and help understand that project is governed by a set of technical and artistic parameters worked simultaneously. Finally the third block (last year), I titled as the autonomy in the project, where the thematic workshop allows you to begin to

> specialize. Here already we have acquired the necessary knowledge to be able to defend the project at all levels (Anna Castella 2015).

Models, sketches, schemes, diagrams, etc. made by the student in the initial phase of the project, has to be incorporated in the portfolio, in order to explain graphically that creative process developed in each project. From our Department, we have to insist on the value of the drawing and representation in the planning process. It must be assessed, therefore, the sensitivity of the student to this matter and its application in the different subjects, to explain graphically architectural concepts and spatial and constructive solutions.

Diana Martinez details in your e-portfolio project for the construction of a community of houses in the District of Poble Nou and explains that the study and analysis of the urban location is essential to understand its proposal, because the intention is to increase the level of interaction with the place. This draws a detailed site plan and makes models and previous studies using historical maps to detect values and signes of the place and what has been conserved most faithfully and the areas that need reinforcement. The graphical representation plays an important role in the project description. In the connection she write:

> I work simultaneously with different systems in favor to communicate more appropriately in each case. Hand drawing allows me to express in a more intentionally way the purpose of the drawing (…). The design process without esta most important form of human creativity yields, in my opinion, an end product less inspiring and less responsive to human needs. Drawings express the interactions of our minds, eyes and hands. For This reason, students studying architecture should be encouraged since the first year to develop their drawing skills." (Diana Martinez 2015) (Fig. 5).

And the same student reflects on the importance of drawing during the learning process:

> In the first year of the degree, it is essential to acquire the basic information for architect's drawing as the proportions and perspectives. For this reason, we focused on hand drawing outdoor spaces where the presence of perspective is appreciated. Furthermore, we learned to draw people and trees, all of which are always present in every drawing of an architect.
>
> During the following years, hand drawing has become an indispensable tool for expressing my ideas, even to represent the sketches of my projects. Therefore, I have been unconsciously improving this architectural representation, as we can see in the perspective I have done in my last year of degree, with a higher degree of accuracy and including the atmosphere generated by the presence of light. (Diana Martinez 2015) (Fig. 6).

Primarily the acquisition of knowledge is explained from the subject of the project that feeds from the subjects studied simultaneously. In this subject is where the student must be able to apply and interact the knowledge acquired in other subjects.

"Moreover, this cross-learning is the reason that gives us our personality as an architects. Each one puts on the desk its preferences and there will be who feels better choosing towards the theoretical design of spaces and who feels better choosing towards the technical progress and the structures optimization. The many areas that the architecture comprises make the multiple architect's profiles possible,

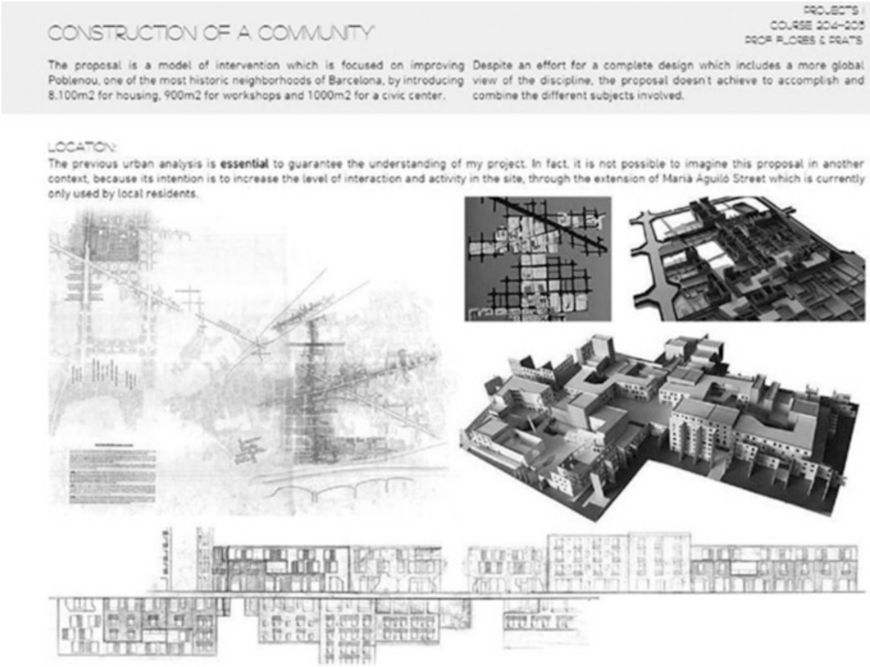

Fig. 5 Diana martinez. Projects, building of a housing community in Poble Nou (2014–2015)

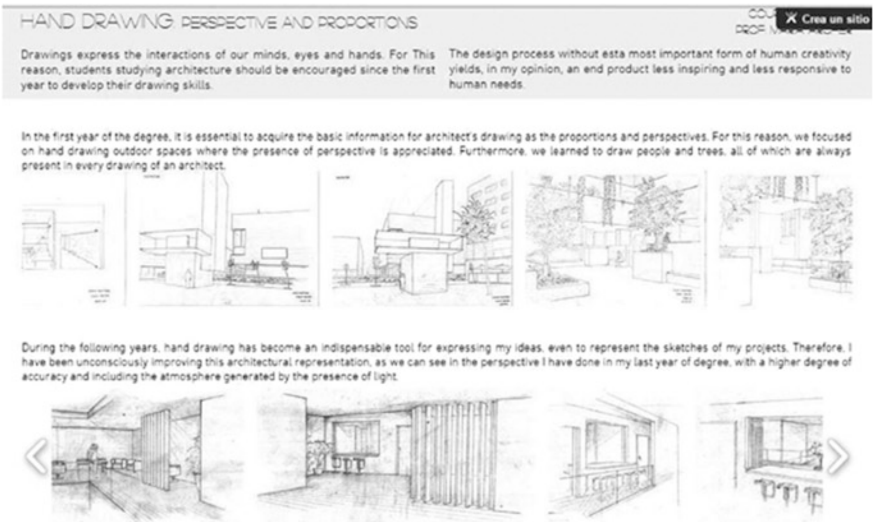

Fig. 6 Presentation of drawings selected by Diana Martinez

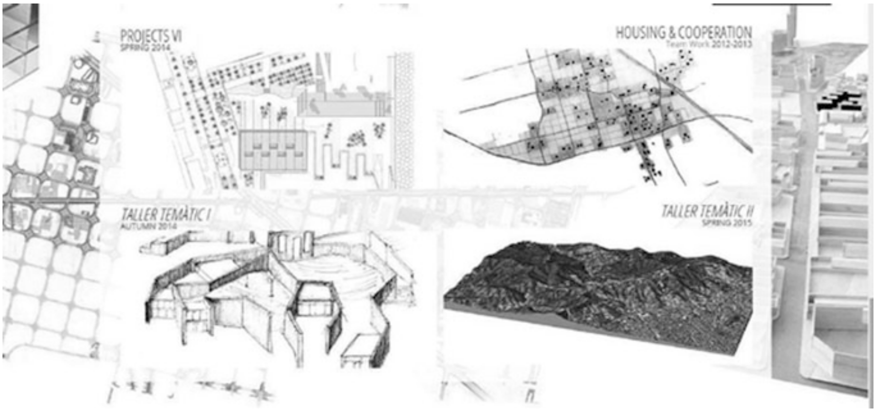

Fig. 7 Irene rodriguez. Representation and drawing in the project

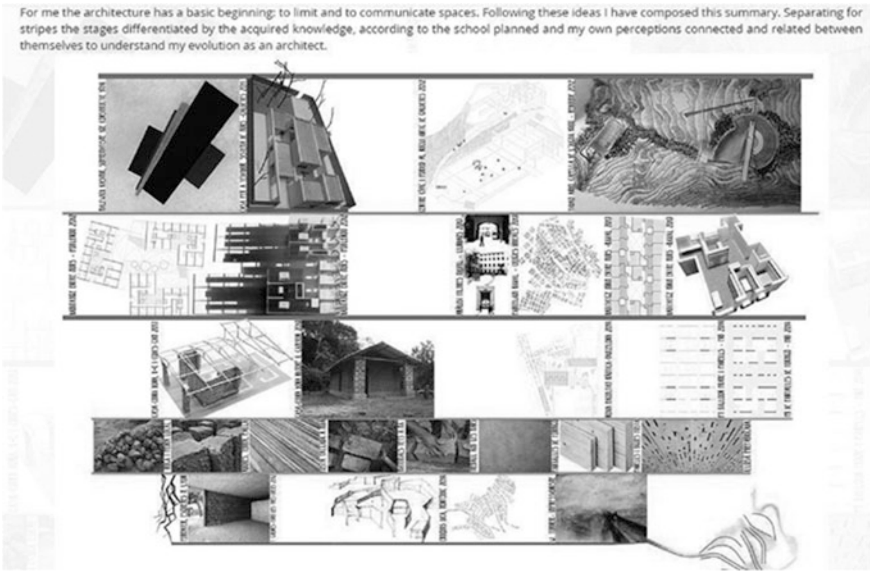

Fig. 8 Irene Rodriguez cross-learning organization

with different way of understanding the world and different preferences to be related with him.

For this reason, I have thought about how I feel as an architect, how I usually work and in what fields I feel more comfortable and I have summarized my ideas evolution throughout these years in the school.” (Fig. 7).

Irene Rodriguez organizes the page of the transversality of the discipline in a series of rows, which brings together works that keep including a connection or that have brought specific knowledge for the development of other matter, without following a chronological order, but establishing relationships, evidences and records useful between the acquired knowledge.

"For me the architecture has a basic beginning: to limit and to communicate spaces. Following these ideas I have composed this summary. Separating for stripes the stages differentiated by the acquired knowledge, according to the school planned and my own perceptions connected and related between themselves to understand my evolution as an architect" (Irene Rodriguez 2015) (Fig. 8).

The transversality of the discipline and its teaching is also implemented through workshops, seminars and cross-work. All this is interacts in the e-portfolio, learning documentation, achievements and experiences, immediate reflection and retrospective reflection, organization and evaluation, among others.

5 Personal Contribution

Students complete their training with extracurricular activities. Mostly they expand your resume with experience in professional studies, specialization courses, congresses, exhibitions, contests for students, language learning, collaboration with NGOs of universities without borders and travel through the architecture visited, photographed or drawn. In this sense it is very important students do not forget travel drawings, and they shall bring with them always a sketchbook to draw.

Present generations have the advantage the exchange of cultures is easier through Erasmus and organized trips of architecture. These stays in other countries are very positive for the evolution and maturity of the student. Architecture trips represent something very important in direct learning of the profession of architect, through experience in situ the work done by other professionals. The student develops an analytical look at architecture visited through those magical moments that allow a continuous transmission of feelings and knowledge with these experiences. All this experience is almost as important as studies of architecture, since they complement the education of the student and is an opportunity that the student has to take advantage of.

To conclude the work of the e-portfolio, the student develops a research work by analyzing of its interest you, either in the field of technology, representation, projects or urban planning. Among the works developed some deal with the own experience in projects of minimum housing and building systems in underdeveloped countries made through NGOs of universities without borders, as it is the case of Irene Rodriguez in Cameroon or Lorena Hernandez in Medellin, program where social housing of self-construction of 30 m^2 is developed. In Cameroon, Irene Rodriguez carried out a collaborative project with the inhabitants of Ndjore II, through the non-governmental organization Codigos-cam and the University Sense Fronteres (USF), jointly with the Centre for cooperation for the development of the UPC (CCD-UPC) with the aim of improving this rural settlement by means of low-cost housing. These partnerships serve as a link and facilitate the work of the

Fig. 9 Experimental social housing in medellin. Lorena Sánchez research work

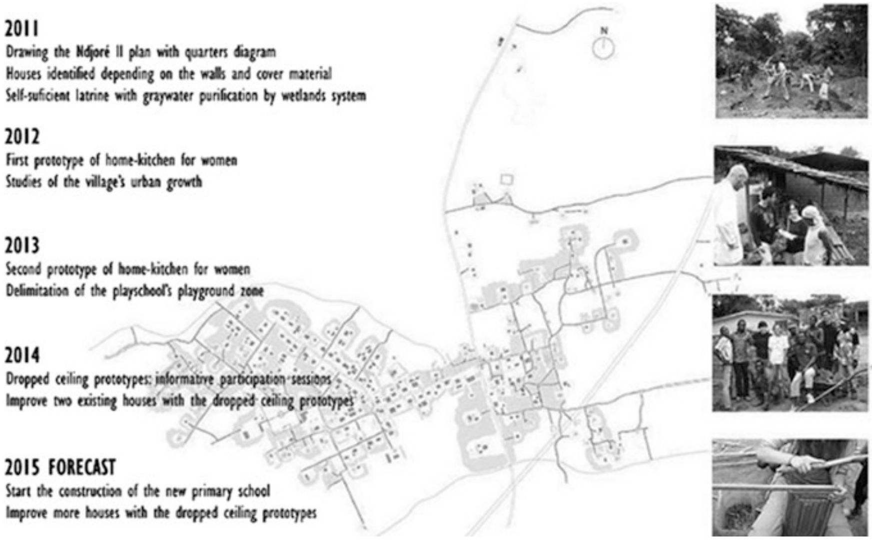

Fig. 10 Research work of Irene Rodriguez based on a collaborated experience of an NGO from 2011, in Ndjore, Cameroon

following students who want to investigate and to experience in the field of this architecture, so that they know their work and priorities to continue working as a team (Figs. 9 and 10).

The works of research, which are structured, designed and presented by the portfolio, can be developed later in Qualifying Master.

6 Conclusions

"The electronic portfolio not only is an electronic learning portfolio, its great potential could be used in other professional fields. In the field of education has extended its use as a technique for gathering evidence and competencies rather than integrating evaluation in the teaching-learning process by collecting samples of learning activities at key moments and reflecting on achievements and difficulties encountered in the scope of both generic and specific competencies that had been proposed, showing their ability and progress." (Dominguez-Garcia et al. 2015).

As it has been seen along this communication, the e-portfolio is becoming one of the techniques that best reflects the skills that the student has acquired over studies of architecture, as well as the learning process to get these achievements. It also shows the student creative, graphic, and compositional skills. In a territory as the architecture, with its multidisciplinary character, is essential that capacity graphically explain the skills, materials, interconnects, and process of learning during the degree. Therefore the design of the portfolio is valued and a level of graphic expression of quality is demanded. Regarding the use of the portfolio as a tool for learning and assessment, it is demonstrated that students exercise their critical ability, synthesis, organization structuring and communications.

From this perspective, the interaction processes social and cultural context in which develops the student and the active role of the same are fundamental. Students reflect on their own learning and structure their knowledge, research and experience, with criteria that are clear and coherent, that it reveals its capacity for self-criticism and reflective. The student also works on the cross-cutting coordination between content of different courses and subjects, essential coordination for the improvement of the teaching quality of the Final Degree Work.

The whole of this process of consolidation of the knowledge about the architecture, with the incorporation of complementary activities and reasoned explanation of how these extracurricular activities have influenced and interested in the students, is a good training for the future architect to address the challenges posed by the world of work and the socio-economic context. Since this approach the portfolio also becomes a essential tool as business card and curriculum in offices, town halls and other entities.

On the other hand, the e-portfolio allows to create and manage a virtual space, academic and professional, between students and teachers, which reflects on the importance of the activities carried out. These tools enable to develop and evaluate this learning and also represents a positive experience for teachers, since that compels us to reflect on the shortcomings and the criticism that the students exposed, in order to correct those errors and provide useful data. It will allow us to improve the coordination between subjects and have a global vision of the degree studies.

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MOOC-Graphies: Possibilities for Online Graphic Learning

Jorge García Fernández, Juan José Fernández Martín and Jesús San José Alonso

Abstract In 2013, two research groups—the Architectural Photogrammetry Lab and the Spanish Observatory of Heritage Education—were authorized to create a digital course addressing the most recent challenges in architectural heritage: *identification*, *documentation*, *representation* and *communication*, which means drawing in a global sense. The massive open online course NEP: *New Educational Strategies to Safeguard Cultural Heritage*, approved as innovative teaching project by the University of Valladolid, was offered during the 2013–2016 period to achieve this goal. In addition to reviewing the different approaches on *MOOC-graphy* to date (focused on the area of architectural graphic expression), the purpose of this paper is to analyze the course's strengths and weaknesses.

Keywords Heritage education · Mooc · Teaching quality

1 Introduction

Our survival depends on our capacity to adapt (Darwin 1859), requiring an increasingly rapid *pace of adaptation*. This has been particularly true in academia, where factors like communications strategies, enrollments and increasing student digital sophistication demand adaptation not only by the faculty but also in courses and their content (Asun et al. 2013).

In the 21st Century, the evolution of traditional systems of instruction has been in the direction of developing new models of e-learning (Johnson et al. 2014) such

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as MOOC-based learning, flipped classrooms, learning based on video games, and others. All of these feature significant transformation, both in their settings and in the structure of their contents (with a digital orientation) as well as an attitude change in the integration (involvement) of the participants: students and professors.

MOOCs (massive open online courses), understood as tools of "social" learning based on a collaborative system, constitute one of the recently mentioned "evolutions" in open-access education (Eco 2015). Among their many possibilities, MOOCs have the capacity to broaden access to education by virtue of their ubiquitous nature, and to improve instructional quality and productiveness (Fontal 2003; García-Fernández 2014).

Several individuated definitions will serve to clarify the key terms. First: *massive* refers to an unlimited capacity to accommodate students while overcoming physical and linguistic barriers. Second: *online* means regardless of distance, without fixed location and at no set time, with an agenda that can be individualized. Third: *open* signifies free, economically unrestricted, only for personal interest, and with direct motivation. Fourth: *massive* implies unrestricted enrollment and unlimited potential to accommodate students, with prior selection according to knowledge or interest: Fifth: *course* presumes a syllabus with schedule, objectives, goals, qualified instructors and appropriate methodology. Finally: *social* in nature signifies that these courses are designed around social media using a *connectivist approach to learning* (Kop 2011), recycling and re-using previous knowledge, generating new knowledge and involving all participants—students as well as professors.

2 The NEP Course

In 2013, two research groups at the University of Valladolid, the Architectural Photogrammetry Lab [Laboratorio de Fotogrametría Arquitectónica—LFA] and the Spanish Observatory of Heritage Education, were selected to conduct the Instructional Innovation Project during 2013/14 (and renewed for 2015 and 2016) to develop and coordinate a program of innovative instruction. The main goal was to give direction to some of the most important challenges in architectural heritage studies: *identification, documentation, representation* and *communication* which, taken together, signify *design*. A MOOC entitled "New Strategies to Safeguard Our Cultural Heritage Assets" ["Nuevas Estrategias para la Salvaguarda del Patrimonio Cultural"—NEP] was created to make progress toward this goal (Fig. 1).

The NEP course offers a new way of understanding the concept of heritage assets, a new means of documenting those assets, and a new system to disseminate information and raise awareness—in other words, a way to discover, connect and share interests in cultural heritage assets that will allow us to sustain (keep from losing) cultural assets, including assets in disrepair. In order to accomplish all this, the involvement of the public (converted into students) is essential to the process of identifying, documenting and communicating cultural heritage (especially its tangible elements) in the educational arena (Fig. 2). The NEP course poses an

Fig. 1 Roundtables and meetings to discuss course content, procedures and results

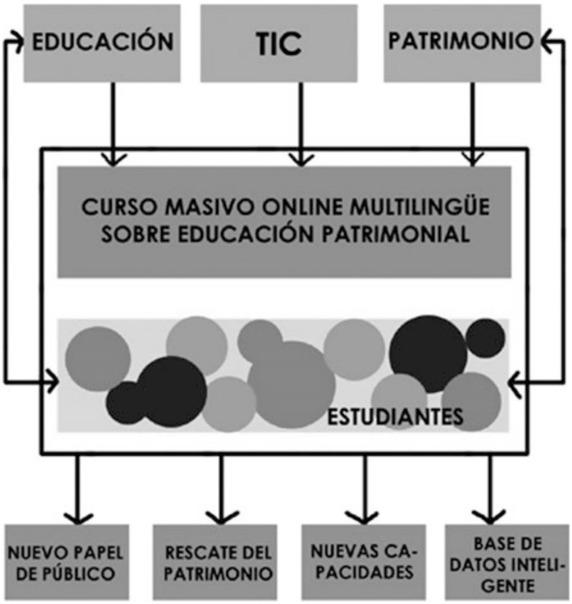

Fig. 2 Course structure based on the triad of education, heritage assets and information/communication technologies

attitudinal change in the relationship between students and education, affecting student involvement in the tasks of administration and development, transforming them into active participants in the project and facilitating the development of a self-administered and sustainable course that utilizes online resources to help strengthen the process, with minimal outside participation.

The student's effort to learn and the project members' endeavor to teach, united in the course "Strategies to Safeguard Heritage Assets", are ultimately intended to (Carreras y Pujol 2009):

– achieve a more prepared society (a new role for the public as key participant in the processes of teaching and learning),
– create digital resources (in the form of an intelligent database) to avoid the destruction of our heritage assets,
– forge a new educational path through education that is online, massive, free, open and based on a digital culture (new knowledge-based capacities for innovation),
– present and consolidate community-based heritage rescue strategies.

Courses that take advantage of information/communication technologies are developed not in isolation, through the use of tools and applications, but through strategic planning to promote changes in how we understand the knowledge that is created, the products, tasks and activities – grounded in a digital context. They also involve the most current lines of inquiry into research on information/communication technologies applied to cultural heritage assets, such as:

– documentation of heritage assets using digital tools: non-expert digital photogrammetry,

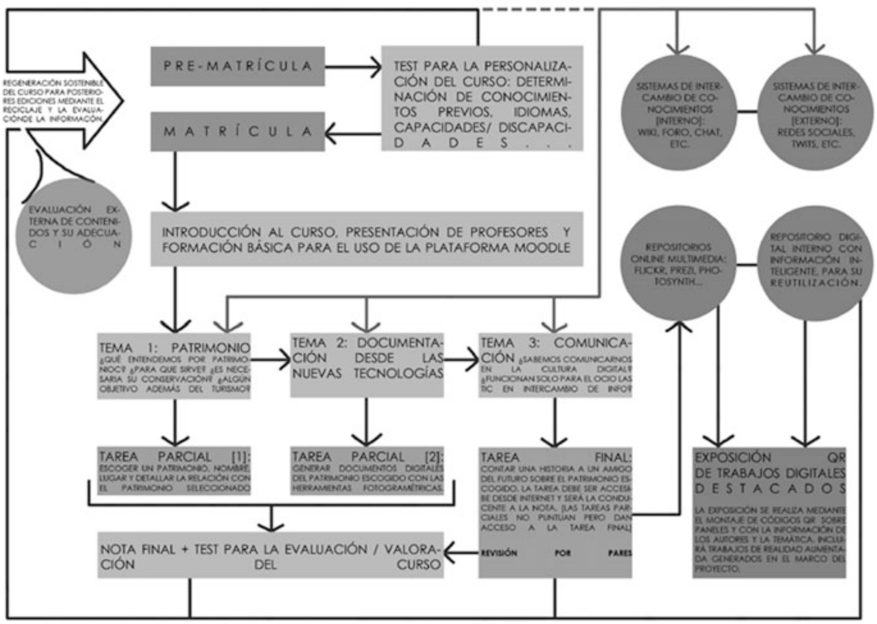

Fig. 3 Flow chart for the NEP course

– heritage storytelling using resources based on the internet, global positioning systems (GPS) and cross-media models,
– teaching strategies based on e-learning and mobile learning.

The course is divided into three sections, each lasting two weeks. Each section has a lecture component, at least one discussion forum and two assigned activities (one per week). While these represent the minimum elements, each section coordinator is free to add resources that best suit the objectives of the particular topic. The structure is summarized in Fig. 3. The topics of each section are as follows:

3 Section 1: Cultural Heritage Assets

Description: "(This section) elaborates on the concept of the heritage asset, offering a new vision based on the relation between individuals and heritage objects. It analyzes this relation in depth at an individual level and examines how this kind of association has spread gradually throughout the entire society, ultimately resulting in the creation of specific legislation." (Fontal Merillas et al. 2013).

4 Section 2: Documentation of Cultural Heritage Assets

Description: "The section reflects on the following questions: What does documenting something mean? For what? How and with what? Why and for whom? It reviews the methods and systems of documentation and provides guidelines for achieving desired goals using available resources." (Fernández Martín et al. 2013).

5 Section 3: Heritage Storytelling

Description: "The section will be taught using the vehicle of storytelling focused on the area of heritage (heritage storytelling). We will examine the origin of this concept, its main elements and how it is put into practice, as well as its platforms and some of the main tools that it employs. Each week is devoted to a particular topic: at the end of the first week, you should be able to identify a heritage story that interests you and the best way of organizing the story's elements in view of your objectives and your audience. At the end of the second week, you will use a storyboard to tell the story, employing a cross-media strategy." (García-Fernández y Medeiros 2013).

6 Degree of Successful Performance

One of the key parameters for measuring our course performance is the dropout rate. The typical dropout rate for MOOCs, according to the ESSEC Business School (cited in Universia 2014) is higher than 90%.

A detailed analysis of the main causes of dropping out is provided by Quillen (2013) and summarized in SCOPEO (2013, 40–41):

- *Curiosity:* "Some people only want to see what is going on."
- *Interest limited to one part of the course:* "Some students would like to learn specific skills in a course without completing it."
- *Lack of financial motivation* to finish the course.
- *Lack of interest in the methodology and/or topic:* "(…) because of how MOOCs are organized or conducted, their content and/or the way they work, (or because) the course's demands are too great and they are unable to continue."

To reduce the impact of these factors, the NEP course design adopted three basic measures:

- Anchoring the instruction in a *connectivist model* where learning is centered on the acquisition of skills through exchange among students and student-professors. The course is conducted like a social learning network, unlike traditional instructional models where learning is separated into content (for the transfer of knowledge) and assignments (to demonstrate the acquired knowledge).
- Restriction of the number of enrolled students in order to achieve more individualized follow-up: although the course has the capacity for massive enrollment through the Moodle platform, we decided to limit the first two offerings of the course to 50 students. This decision may restrict the use of the term "massive", although we would argue that it is impossible to describe a course as "massive" if it leads to students dropping out.
- Prior selection of students: a preliminary triage was performed by means of an open questionnaire. From a total of 150 applications, 50 were chosen based on the criteria of fit between interests and course goals, previous knowledge, and interest in the quest for new knowledge. Two examples of selected responses (from 2013 to 14) are shown in Table 1.

Other parameters to measure the performance of the students have included continuation and interactivity. As shown in Fig. 4, we made comparisons with data from a 2012 Duke University bioelectricity course that was selected because of the reliability of the data published by SCOPEO, which monitors webbased training.

Continuation for the bioelectricity course was 2.5% as measured by the percentage of registered students who ultimately earned a certificate. The comparable

Table 1 Responses to the open questionnaire to select participants in the NEP 2013/14 course

"My name is Jennifer de Jesús and I consider myself to be a hybrid traveling between architecture and psychology. I do not imagine space without mind or mind without space, and therefore I believe it is essential to learn both disciplines in order to act in both realities. The study of human behavior in a two-way relationship with an environment that is arranged and defined by man is what allows us to take conscious action in the city and to create spaces that promote ownership, attachment and cultural exchange through their architectural integrity, ultimately re-creating the city of our dreams. In order to build the future, we need to act in the present; and to act in the present, we need to be familiar with our past. Cultural heritage assets are our collective memory, the guardian of our identity. There are places that allow us to understand who we are; their disappearance disrupts a part of us, creating a hole in our future identity that we can only fill with memories, although these—like all memory—run the risk of being forever lost in time. This is why I believe it is essential that we conserve, preserve, disseminate, reutilize, regenerate and become familiar with our cultural heritage assets. I am drawn to this course because I am interested in becoming the "guardian of paradise" (https://www.youtube.com/channel/UCkaQqiGUQsVUTMHqkWpTjLQ/), the guardian of our history, of our past; because I believe in a collective future and want to build it in the present through our heritage assets. I also think it is correct to take a technological approach and to make use of all the easily accessible multimedia resources we have available to us at no cost in order to accomplish this learning and this subsequent mission. The social networks and virtual platforms are a quick vehicle for communicating information that we can use to get closer to those places, or those times, that are far away from us"
Jenifer de Jesús, Spain
"The more awareness we have of our local stories, of what our peoples have experienced, and of what we are, the closer we are to taking control of the future and knowing how to respond as societies to the challenges posed by modernity, as diverse as these may be in each of our countries. In this sense, the search for forceful realities of and for the people involves not only the projection of issues with an eye toward the future, since we also need to have a long look at the past. It is in this view of where our heritage is written, incorporating traces of what has been lived and built—in palpable reality or in our minds. This is the identity of the heritage asset. My name is Carolina Gómez. I am a Colombian-Ecuadorian historian based in Quito for the last five years. My work involves research and cultural management. I am a part of Churofilms Cultural Productions. This is an agency in Ecuador that combines filmmaking and historical research. I would like to participate in the course in order to expand my knowledge of historical assets and in this way equip myself to use new tools in my investigative work. For this, I would like to earn a course certificate, and I am therefore prepared to play a significant role in the class. Our recent work has involved the documentary "Tierra Adentro" ["Inland"] as well as the audiovisual exposition "Viaje a un Memoria de la Tierra" ["Journey to a Memory of the Earth"], in which we show films from 1949 about an earthquake that year in the Ecuadorian province of Tungurahua to residents of that province. This film production, which won the 2013 prize of the Ecuadorian National Council of Cinematography, provoked awareness of one of the most significant natural disasters in Ecuadorian history. http://www.youtube.com/watch?v=ZjlENok_5xA"
Carolina Gómez, Ecuador

figure for the NEP course (2013/2014) was 36%. Regarding interactivity with the resources, the Duke University sample showed a notable decline while the NEP course, measured over the first six weeks of the program, showed almost constant growth in interactivity (Fig. 5, right).

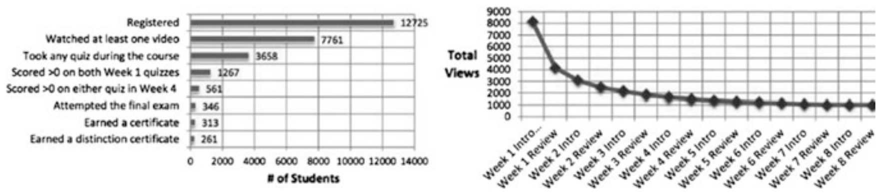

Fig. 4 The Duke University bioelectricity MOOC expressed in figures: student continuation (*left*) and video viewings by week (*right*); data by Scopeo (2013, 39)

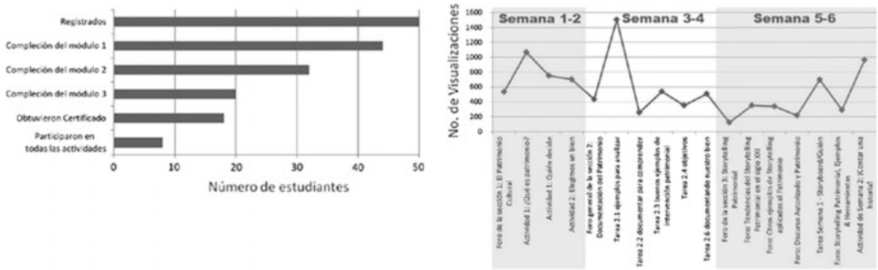

Fig. 5 The NEP MOOC expressed in figures: student continuation (*left*) and interactivity in forums and weekly activities (*right*)

7 Analysis of the Course and Generalization from the Experience

The analyses have revealed the keys to beginning the process of updating, improving and consolidating the NEP course for the future. These may be summed up as follows:

- Weaknesses and barriers: It is difficult to evaluate the knowledge gained by the students. With a system where content is communicated online and evaluation is achieved by a test, it is not possible to evaluate the progress of each student in the course. Moreover, the prototype structure of these first two versions of the course did not allow for an enrollment of more than 50 students, thus excluding over 150 students who had expressed interest in participating in each respective course.
- Strengths: Student collaborative work arrangements, creation of educative digital products, new approaches by students to heritage asset rescue, transforming them from simple spectators into creators of knowledge.
- Proposed solutions and improvements: For the next version of the course, we propose the introduction of creative mapping to indicate graphically and in detail the relation between students and content; students and students; and students and professor. We suggest expanding student enrollment capacity in the

course and adapting it to various languages (English, Italian, Portuguese) in order to extend its outreach.

The project remains currently active, and it has been included in the University of Valladolid's annual plan for 2015/16 as a project for instructional innovation. In addition, it has been adopted as one of the initiatives of the Spanish National Heritage Plan.

8 Conclusions and Guidelines for Future Research

The development of the NEP MOOC addresses the need for a society that is increasingly prepared, knowledgeable and sensitive to the conservation of heritage assets. Its ambitious effort to reach different audiences in a unifying way (free and accessible by different populations) produces a direct impact on various levels of society while simultaneously expanding its scope beyond the use of information/communications technology as a vehicle for networking and information transfer.

Moreover, the application of new educational trends based on collaborative work and instructor coaching has been strengthened by the application of new technologies and virtual environments, starting from a vision of social responsibility in education (the public in the role of main participant).

Modifications to the typical structure of MOOCs, including reducing enrollments, filtering students according to their interests, and promoting more individualized interactions have resulted in an increase in the continuation rate to over 35%. Additionally, the tangible results of student learning, awareness raising and attitude transformation allow us to confirm the applicability of MOOC-based learning. This is particularly the case with topics such as graphic representation, which requires a high degree of interactivity with visual resources.

In the next edition of the NEP course, we intend to build in key lines of research and action to enhance the strengths we have uncovered, while eliminating the weaknesses. Our plan includes:

- Creative mapping to analyze the evolution and evaluation of students within the course.
- Augmented reality and serious games resources to promote knowledge transfer (based on information/communications technology) from other fields.
- Collaborative digital workshops as vehicles for strengthening instructor coaching.
- Multilingual platforms for student-to-student and student-to-professor interactive communication.

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PBL. Problem-Based Learning Cross-Application to the First Year Graphical Courses of the Degree in Architecture

Ignacio Cabodevilla-Artieda, Taciana Laredo Torres and Aurelio Vallespín Muniesa

> *Students have been accustomed to dogmas and conclusions, to eat the hunted and seasoned cat, and get exhausted when hunting the hare.*
> (Miguel de Unamuno, 1899)

Abstract The implementation of the European Higher Education Area (EHEA) requires working matters and projects transversally in the different subjects. The methodology applied so far has not provided the desired learning outcomes; after a research and training carried out by the professors of both subjects, several changes to the methodology will be implemented next year. PBL is a good methodology to break the vicious cycle of the general principles about teaching and to experiment with educational innovation in order to engage the students in their own learning process.

1 Introduction

This paper stems from the need to adapt the architectural graphical expression course plans to the European Higher Education Area (EHEA). This plan of European convergence in education requires cross-work of the contents of different courses to promote the acquisition of skills, a combination of knowledge and understanding, that allow students to face real situations, necessarily complex and multifaceted, that need to be solved using multidisciplinary resources.

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The Bologna Process divides learning into three sequential academic stages: Bachelor, Master and Doctorate. In the first one, the bachelor's degree, the specific skills and knowledge of the discipline are obtained, in order to be able to successfully develop a professional career; a specialization in a specific field of knowledge within the scope of the prior qualifications, training students to manage their own learning is obtained through the master's degree; finally, the third stage culminates with the presentation and defense of the doctoral thesis, an unpublished work of research, with which the students demonstrate their ability to develop an autonomous and critical research.

To meet these needs posed by this new system, existing teaching methods such as lectures and seminars have been adapted, and some lesser known methods such as case studies, project-based learning, collaborative learning, active-cooperative systems or problem-based learning have been tested; unlike the traditional methods, the new ones focus on the students and turn them into the centerpiece of their own training, transforming the teacher into a facilitator and guide within the learning process.

2 Problem Based Learning (PBL)

Problem-based learning PBL is a good methodology to break the vicious cycle of the general principles about teaching and to experiment with educational innovation. Teaching methods that focus on the students' learning turn them into the real axis of university education as the teacher becomes a mediator or guide. The problems that this methodology is based on consist of a description, in very simple and hardly technical language, of a set of facts that pose a challenge and require an explanation. PBL intends that students learn to behave as a professional, able to identify and solve problems, to understand the consequences of their own actions and the ethical responsibilities involved, to interpret data and design strategies using the necessary theoretical knowledge to solve the problems.

This way the students are committed and aware of the needs and difficulties that the problem poses for them; thus they look for the theoretical base needed to find a solution. The practice of this method will reverse the current order which involves delivering the lecture and then practice the contents of the lesson, starting the new one with the problem formulation, analysis and identification of needs, and search for the theoretical contents necessary to reach a solution (Fig. 1).

This teaching method was introduced in university teaching at the Faculty of Medicine at McMaster University (Hamilton, Canada) in the 1960–70 decade. Unlike educational systems used so far, PBL follows a constructivist approach, that is, it considers the fact that students understand and are more fluent in the syllabus but also *learn how to learn* by taking part in the construction of knowledge instead of receiving it from their teachers in a passive way.

PBL shows some particular characteristics that separate it from traditional methods:

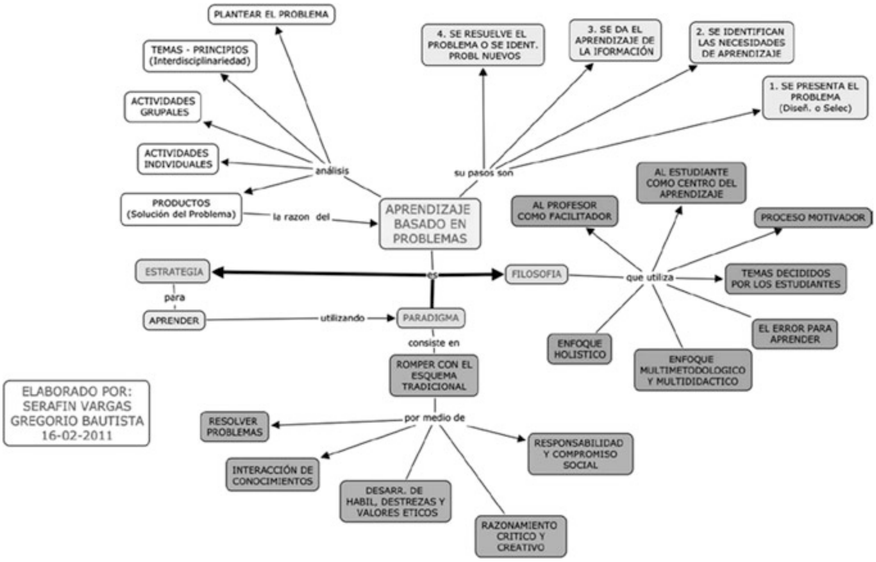

Fig. 1 Problem-based learning

- Learning is focused on the students.
- It is an active method, with continuous involvement of the students.
- Collaborative work in small groups is promoted by the teacher as facilitator of the learning process.

Maastricht University was the first to apply this methodology on a large scale in every degree. To support and organize the learning process of the students the university developed *the seven steps to wisdom* (Maurer and Neuhold 2012), explained in Table 1.

This method has been implemented in many faculties, schools and courses throughout the world with slight variations to the canonical method of Maastricht University.

3 PBL in Architectural Teaching

PBL experiences in architectural teaching to date have been focused almost exclusively on the courses of installations, with no cross-relation to the rest of the syllabus. The two most relevant exceptions are the Faculty of Architecture and the Built Environment of the Technical University of Delft (TUDelft) in the Netherlands, and the School of Architecture and the Built Environment of the University of Newcastle in Australia; for a certain period, both have based in PBL their entire syllabus.

Table 1 The seven steps to wisdom

Phase	What to do?	Why?	Possible deficiencies
1. Clarification of terms and concepts	• Ask for the clarification of unknown terms *Discuss what the images provided show	• Establish a common base • So that every member of the team understands the formulation of the problem	• Detailed discussions about some terms • Wrong explanations made by the students (the teacher must intervene) • The students await the explanations of the teacher instead of collaborate to find the answers
2. Identification of the problem	• Set an initial title for the problem or formulate a broader question	• The students immerse themselves in the work and find "the underlying problem" • They establish a common starting point and search for wider connections	• Neglect formulation of a complex problem • The students identify the field of study with the problem • The students write the title of the problem but often they do not understand it
3. Brainstorming	• Collection of ideas and possible explanations	• Establish and contrast; what the group knows and what it wants to discover • The students establish the aspects which they consider interesting and relevant • Activation of prior knowledge and real-life situations, the problem must be linked to already acquired knowledge	• The students extract and write down words of the formulation, deconstructing the assigned work instead of focusing on their learning • They do not explain some thoughts (the teacher must ask for an explanation) • They are not creative in the search for possible solutions and focus on the identification of facts
4. Categorization and organization of the first ideas	• Identification of keywords (answering questions as: why, how etc.)	• Organization of the first ideas to find patterns and ease the setting of few learning goals	• Difficulty to identify patterns • Unexplained random grouping of ideas (the teacher must intervene)

(continued)

Table 1 (continued)

Phase	What to do?	Why?	Possible deficiencies
5. Establishing the learning goals	• Use the different categories of ideas in order to establish goals and tasks	• Establish clear research goals to reduce the field of investigation • Counsel and guide about the needs to solve the problem	• Careless setting of the goals (distinguish how and why, etc.) • Inclination to count on the teacher to set the right goals • Lack of initiative to search for solutions beyond the initial sources
6. Personal study	• reading of texts, search for additional sources of information, response to the established learning goals	• Individual responsibility and independent work	• Lack of dedication to independent work • Superficial Reading of the texts and difficulty to obtain the main ideas • Recollection of work of former students: lack of effort and individual work
7. Discussion about the results	• The students explain their work and methods to achieve the goals • They compare their results and reasoning	• A wider comprehension is obtained than just through memorizing • Identify the potential misunderstandings of empirical facts as they know their classmates' reports	• They Exchange facts and knowledge but do not achieve the learning goals • They do not understand the true nature of the problems, their complexity and depth

The Council of the Faculty of Architecture of Delft decided to implement PBL in 1989 in order to alleviate the grave deficiencies in the education of the students (Bridges 2006). The basis of the syllabus consisted of project courses complemented by a wide variety, both thematic and qualitative, of courses on technical matters and personal skills development; this system produced graduates with large gaps in wide fields necessary for the professional practice, an extremely complex administrative management of an institution with 2500 students and very high operating costs that raised the need for a radical change in order to prevent the closure of the faculty.

The new syllabus was divided into two sets of two years each. In the first of these sets, basic knowledge and skills of the architect were developed for twelve periods of six weeks each in which knowledge was acquired transversally; the main work issues were housing, the construction process, the building surfaces, program, form and function, technical systems, wet areas, renovations and second uses, materialization, the city, and the environment. The students worked in small groups with teachers as guides for the debate on the problems, with architectural design exercises limited in their temporal length, and some seminars on the hardest topics to understand and study. The third year of study is devoted to a mixed training of core and elective courses to provide the students with some knowledge of the various options of specialization: architecture, construction management, construction technology, residential design, and urban design.

The adaptation of the entire syllabus was hasty and imposed on the teachers of the Faculty, who received the first specific training on PBL in January 1990, a few months before the new system was put into operation; the methodology was applied from the first semester of the 1990–1991 academic year, without the proper organization and making the professors of the Faculty responsible for the generation of all necessary materials: problems, workbooks, methodological guides, etc. The students received no training on this new way of working in their studies, which involved a great change from the usual methods in the Netherlands. All these circumstances caused a great initial rejection of the methodology, which was reinforced by an overly literal application of the principles of the University of Maastricht (the seven steps to wisdom), suitable for studies of medical or legal practice, but not for the holistic aspects of the knowledge needed by an architect.

After the adaptation of the syllabus to the Bologna Process, this system was abandoned; currently the bachelor's degree takes three years and the master's degree two more, with changes in the possibilities of specialization offered: architecture, construction technology, residential design, landscape and town planning. PBL has disappeared from the curricular guides and it is used only in an accessory way in some courses.

The School of Architecture of the University of Newcastle was in a completely different situation to that of the Dutch faculty (Bridges 2007). The number of students was the lowest among the fifteen institutions where a degree in architecture could be studied in Australia, and the teaching staff was very unstable due to the poor work and economic terms as well as academic prestige conditions the department could offer. The faculty decided to implement PBL after a process of discussion and study of different alternatives, by consensus of the faculty, school management and University council.

The application of PBL focused on architectural design, integrating other areas of knowledge through the solving of various case studies based on real situations of professional practice, with the support of the Faculty of Medicine at the same University, which used this method since 1976. The most useful problems in medicine are those looking for a clear and specific solution, a diagnosis, while there is not just one correct solution but many of them for a problem in architecture; thus, design workshops were strengthened as well as the relationship with a number of technical modules, replicating the working ways of professional practices. The new syllabus became effective in 1985 for the first-year students scheduling its progressive introduction in later courses, but due to the request of the students themselves, it was introduced in every course within just two years.

Unlike the Delft case, the syllabus was divided from the beginning in a 3-year bachelor's degree and a 2-year master's degree, dividing each year into two semesters, developing completely a problem in each of them, demanding an ever increasing level of definition and linked to a particular typology of growing complexity each year. The study revolves around the problem of each semester, through corrections and periodic presentations of ongoing work and support from teachers of the different areas (building, technical systems, history, etc.); this method allowed a minimum variation of the internal structure of the department and a continued and closer control of the learning process by the teachers.

4 Framework: Prior Training of Students, Courses and Objectives

The training of graphical skills and art history have seriously declined in the secondary education received by most of the students who begin nowadays their architectural studies, delaying, until the first year at the University, the acquisition of the manual dexterity and visual culture that are so necessary in architecture (Redondo 2010), thus this work must be carried out during the first semester.

Graphic courses in the first year of the Studies in Architecture Degree at University of Zaragoza (EGA 1, EGA 2, EGA 3, EGA 4, and Analysis of Architectural forms) take 30 credits, half of the total for the first year, split in the two semesters. The number of students varies between 90 and 100 for each course, divided into groups of 15–20 students per teacher in the practical classes. Each semester consists of 14 weeks, with two sessions of EGA 1 and Analysis of Architectural Forms weekly and a single session of EGA 2, EGA 3 and EGA 4. The workload outside school hours is very heterogeneous, but the courses numbered 1–4 demand weekly deliverables to monitor the course while Analysis of Architectural Forms is passed through the presentation of a final work that acts as a global summary of the graphical courses. The common aim of these is to provide students with the necessary tools for architectural representation and the structuring of space.

5 Collection of Problems Designed for the First-Year students of the Studies in Architecture Degree

The following table lists some of the problems that are being developed during the 2015–16 school year in every course within the architectural graphical expression knowledge area, with the aim to get the attention and interest of the students while consolidating better the program of each and every course (Table 2).

Table 2 Relation of problems for the 2015–16 school year

Course
EGA 1
Problem
In our professional practice we receive a consultation of the owners of a small detached house situated in a village in the Pyrenees; every time it rains water filtrates through the roof and it has already ruined their parquet flooring number of times. They want a repair project that will definitely solve the problem
Goals
–Know orthographic projection system
–Draw intersections of planes
–Roof design; understand how to drain water properly
Documents given to the groups
Roof plan and elevations of a detached house
Course
EGA 2
Problem
We have been commissioned to organize an exhibition about the places visited by Goethe in the journey described in his book Italian Journey providing, in addition to his own visión, that of other artists and architects
Goals
–Framing and composition as a way to transform the three-dimensional reality into two dimensions
–Analysis of proportions and forms in architecture
– Study of various types of lines and codes of representation
–Study of the shadows to express the form of the surfaces, depth, texture of materials, etc.
Documents given to the groups
Each group gets assigned a different city (Verona, Padua, Venice, Ferrara, etc.)
Course
EGA 3
Problem
A client is considering buying a house and has commissioned us to study the possibilities for its refurbishment; the only information available is a series of pictures of all the rooms that the client has taken on a visit to the house
Goals
– 2D CAD drawing - Architectural plans - Understanding of the architectural space and volumetric relations
Documents given to the groups
Photographs and/or drawings of an apartment
Course
EGA 4
Problem
We have commissioned the refurbishment of an apartment in order to be used office and as preliminary information we have been

(continued)

Table 2 (continued)

asked to deliver a series of images representing the setting and organization of the space that we propose
Goals
– Representation of the architectural space – Introduction to the use of color in architecture – Acquisition of new graphical resources (sections, transparent planes, etc.)
Documents given to the groups
Plans and sections of an apartment
Course
Análisis de Formas Arquitectónicas
Problem
Our professional practice gets commissioned to design a house; we have been given a plan of the site, information about its immediate surroundings and each family member has defined how they want (size, orientation, etc.) the pieces that they are most interested in
Goals
– Architectural analysis of a building (surroundings, space, form, function, etc.) – Grouping and organization of the different pieces – Knowledge of different typologies
Documents given to the groups
Plans of the different spaces, interior and exterior, meeting every possible function (kitchens, bedrooms, bathrooms, stairs, patios, etc.) and site plan

6 Results of the Experience in the EGA 2 Course

This methodology has been applied in the EGA 2 course during the first semester; this is a fundamentally graphical course, based on hand drawing in order to understand the spaces and relationships that exist between the various elements of the architecture through the analysis and representation of some canonical models, of geometric forms and increasing degree of difficulty as of their spatial structure.

To strengthen the relationship between drawing and built form we set the following problem; "We have been commissioned to organize an exhibition about drawing and the architecture developed by great masters of twentieth century architecture". No additional material was delivered to the groups except for the commission of a particular architect included in the following list: Antonio Sant'Elia, Erich Mendelsohn, Hans Scharoun, Alvar Aalto, Reima y Raili Pietilä, Mies van der Rohe, Le Corbusier, Oscar Niemeyer, Aldo Rossi, Claude Parent, Frank Gehry, Norman Foster, Lebbeus Woods, Paul Rudolph, Alvaro Siza, Tadao Ando, Steven Holl, Zaha Hadid, Peter Zumthor, Enric Miralles, Gordon Cullen, Rafael Moneo, Alberto Campo Baeza, Bruno Taut and Peter Eisenman.

The main goals of the exercise were the introduction to the knowledge of the work of these architects, the acquisition of a "catalog" of different ways of drawing and designing architecture, and the establishment of a link between the specific way of drawing of each architect and his built architecture. The material that students

Fig. 2 De la Warr Pavilion (Erich Mendelsohn) Students: Paula Acín, Mafalda Aguillo, Alba Aparicio and Andrea Embid

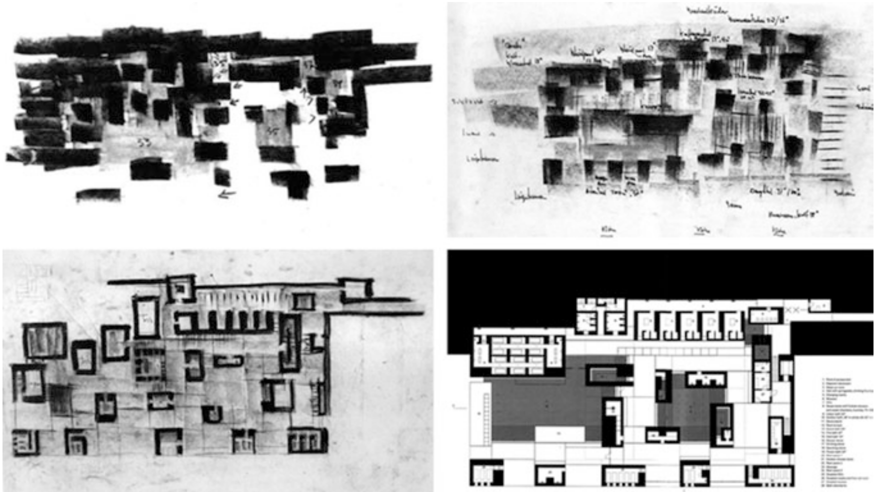

Fig. 3 The Therme Vals Hotel (Peter Zumthor) Students: José María de los Arcos, Pablo García, Jacobo Murillo and Sergio Pérez

should deliver at the end of the exercise consisted of a series of representative images of their research and a brief public presentation of the results (Fig. 2).

The biggest problem we have encountered has been the lack of maturity when faced with a little research project and the scarce recourses displayed in finding information; however, with the support of the teachers and the information service of the library of the University, through a small workshop for information search and management, these initial difficulties have been overcome.

The results obtained by the groups have been very different, presenting in the worst cases a mere biographical and built work resume hardly related to the architects' project or ideation drawings; however, the groups that have followed the methodology with greater interest and dedication have obtained very interesting and valuable results for the introduction of the students in architectural studies, both for the amount of information provided as well as for the proven ability to relate the built work built with its design process.

It has been achieved a high degree of satisfaction among the students who have devoted more effort to the task and it has aroused interest in the graphical tools of the architectural ideation process, therefore we hope that the next experiences will help promote research and development of the graphical skills of the future architects (Fig. 3).

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Paneling Complex Surfaces: From Research to Teaching Between Theory and Practice

Emanuela Lanzara, Mara Capone and Amleto Picerno Ceraso

Abstract The complexity of contemporary forms can be investigated from different points of view. The technological aspect is very important because it is closely linked to the current tools of computational design and digital fabrication, now based on the logic of visual scripting and, therefore, more accessible to a wide range of users. From the past to the present, the architect is called to deepen the basic theoretical contents of the creation and communication of architecture and to optimize the problems that affect the feasibility of the architecture, developing and disseminating new solutions in the professional field as in teaching and research fields. More specifically, in a Ph.D. thesis research developed in the of Ph.D. course of study in Architectural Techonology and Architectural and Environmental Representation at the DiArc—Department of Architecture, University Federico II, Naples (Italy), the topic of the discretization and paneling of complex surfaces was developed to systematize the basic and advanced principles that are capable of supporting the elaboration of possible solutions and innovative approaches to this constructive, economic and aesthetic problem. Concretely, thanks to the collaboration developed during a workshop sponsored by the research center Medaarch—Mediterranean Academy of Architecture—Mediterranean FabLab (Cava de' Tirreni, Salerno, Italy), the object of the experiment was the physical construction of a pavilion standing discretized in planar hexagonal panels. Therefore, this experience demonstrates how the cooperation between academia, research centers and specialized local companies throughout the territory is important because it allows to strengthen and integrate the expertise of all those involved and encourages the development of multidisciplinary approaches. So, this experience is the stimulus and the outcome of a specific search path developed by the Ph.D. thesis research,

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as well as an important opportunity to realize the content of current advanced research conducted within the research field of Architectural Geometry, with important consequences in Sciences of Representation's disciplinary field and, more specifically, of the Applications of Descriptive Geometry. In addition, these experiences represent an important source of inspiration useful to start an innovative and challenging educational offer, organizing equipped laboratories inside universities and specific first level courses. Therefore, to demonstrate and deepen these reflections, it is interesting to show results, theoretical and practical, of the research experience and teaching reflections between theory and practice.

Keywords Paneling · Digital · Fabrication · Theory and Practice

From tradition to today, the architect is called to deepen the based theoretical contents of design and architecture communication and to optimize the problems that affect the feasibility of them. This goal is possible through the development and the dissemination of new application solutions in both teaching and research fields.

> *Today, Any work concerning the discussion of architecture cannot exist without considering the condition of the architect and his figure.* (Florio 2004).

The evolution of a process involves many theoretical and practical areas: always, both are subject to the architect's skills.

Ancient architecture is based on the link between mathematics and representation. Originally, the composition and the perception of the constructive elements were arranged inside euclidean geometric knowledge and space. Historically, architects face problems related to the use of different materials for the construction of the works.

Materials ensure coherence between the architectural language and syntax through which they are structured, for the composition of an architectural order or for the realization of a complex shape.

The development of a highly scientific approach caused the separation between the architect and the engineer, marking future relations and outlining the relative, different profiles.

Sometimes, the current division of skills and the lack of cooperation between those involved in the process generate inconsistent results. In the 50s and 60s, engineers and architects were confronted with a new set of problems resulting from the potential of new machines and new materials. They allowed the ability to experiment with new forms and fluid structures, converged in the design and implementation of shell structures, of tensile structures or pneumatic systems.

Therefore, the design and realization of irregular shapes and structures has always represented a major challenge. The complexity of the shape complicates the feasibility of architectures, necessarily encouraging the involvement of other disciplines. Therefore, it is necessary to grant the design stage as multi-disciplinary activity. It is not correct to speak of specialism, because they strengthen the separation between the different actors involved in the process. Otherwise, talking about improving the knowledge and skills of a particular figure is correct. It is important to develop the stage of formation of future professionals precisely in order to encourage a conscious growth.

Therefore, one of the prerequisites of progress is to pursue innovation from tradition and from studying and teaching the fundamentals that always confirm themselves as valid instruments to support research activities. The past is always a source of inspiration to understand the present and to find viable solutions to current challenges.

The spread of the tools for digital representation needs to find a new approach to the study of the disciplines of the Representation (Migliari 2009). This approach should allow integration of the foundational principles with new techniques, exploiting the potential of these tools: the purpose is to control the knowledge and the design of the forms. The experimental teaching methods that use digital modeling to study the geometry (Capone 2012) is the focus of academic debate for several years in the Italian universities, especially in order to analyze the architecture. Automatic resolution of many problems allows to widen the field of investigation, simplifying the complexity approach.

Certainly, controlling the architecture of a perceptive, constructive and performance point of view is one of the main reasons that encourage the spread of complex geometries.

Generally, these shapes are controlled thanks to the intelligent use of materials models, such as Gaudi's catenary, Isler's inverted membrane or Musmeci's structures; today, they can be optimized through the use of parametric software. In traditional modeling software the graphic interface hides the procedures that structure the image (Filippucci 2012). The software based on the principle of generative modeling allow to control the geometry of a form as a function of one or more parameters and, thanks to the various developed tools, it is possible to establish the system of rules which generate the shapes through appropriate algorithms. Thanks to new tools, architects do not design a priori the building's shape, but they seek to manipulate a series of data, encoded as a sequence of parametric equations, in order to generate a series of possible design solutions aimed to provide a sustainable response to different, new challenges and demands. The opportunity to manipulate the architectural object through the virtual window on computer allows us to focus on the geometric properties of the form and it allows to reason through basic shapes and solids; the purpose is to look for a possible breakdown and simplification of complexity.

If the aim is to optimize performance, the parametric representation becomes a fundamental tool for the designer who will conceive the form no longer as a stylistic exercise but as the best answer to a certain priority, as structural optimization, energy saving, rationalization of construction, or others.

Using these tools, the designer will be able to generate infinite shapes and they will select the most appropriate. Therefore, the exploration of the possibilities offered by parametric modeling becomes a key area of multidisciplinary research: the fields and the case studies can be multiple.

Certainly, human imagination is capable of evoking a surprising variety of shapes, but we have to find a balance between the overall quality of the result and the costs necessary to achieve it. The spread of prefabricated elements, the need to reduce the quantities of trims, the economic restrictions and the design of a sustainable life cycle for the building, requiring the development of new skills by the architect.[1]

Therefore, the computational design is a tool that makes conscious digital design.[2]

Algorithms allow us to rationally solve problems like the paneling, or discretization, of complex shapes and, thanks to their transposition into viewable and customizable elements, they also represent an accessible tool for architects and designers.

This process requires the systematization of geometrical-mathematical principles of the main useful algorithms necessary for the resolution of the problem. Descriptive Geometry is as an appropriate discipline to express and represent these contents.[3]

The search for solutions to this problem is possible thanks to advances undertaken in the emerging research field of the Architectural Geometry, that combines elements of Mathematics, Computational Geometry, Computer, Engineering and Architecture.

The geometry experts currently engaged in these studies consider the optimized paneling processes aimed at the discretization of a complex surface in flat faces and through the genesis of semi-discrete and mixed models (decomposition into developable elements and into single and double curved surface portions).[4]

Sometimes, today as in the past, the purpose of research flip the object of the project activity from the architecture to the elements required to realize every single part of it.

Always, the prototypes represent the virtual place to perform geometric operations necessary to control and to ensure the interactions between the various elements that make up an object.

The surfaces are materially realized to sew individual portions or patches geometrically defined by the paneling operations of the digital prototype.

Modularity is one of the most desired goals to obtain the decomposition of a system, independently of its complexity: inevitably, industrial production prefer to use modular elements, which promote the optimization of manufacturing steps and final products assembly.

Obviously, the use of generative design and specific techniques cannot ignore the study of the foundational principles of the various disciplines, from geometry to technology.

Therefore, it is necessary that these tools fit into the training of engineers and architects as a fundamental integration to the basic disciplines.

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[1]Lanzara (2015).

[2]Tedeschi (2014).

[3]Lanzara (2015). *Op. cit.,* 63.

[4]Cfr. Advances in Architectural Geometry (AAG). 2008–2010–2012–2014.

To demonstrate these positions, research experiments conducted from 2012 within the disciplines of Descriptive Geometry of the *Doctorate Course in Survey Applications and Representation of Architecture and Environment of DiArc, Department of Architecture, University Federico II of Naples (Italy)*, represent an interesting source of inspiration for organizing innovative educational experiences.

Between theory and practice, the goal of this research is theoretical and applied study of the paneling techniques of complex surfaces.

Therefore, this paper aims to describe the experience of modeling, discretization and construction of a curved shell, the Cocoon Temporary Pavilion, in hexagonal planarized elements.

The construction of the pavilion, a discrete self-supporting system, took place during the Ph.D. program, through participation and collaboration in a workshop promoted by the *Medaarch* research centers *(Academy of Mediterranean Architecture)—Mediterranean FabLab*[5] and *Co-de-It (Computational Design Italy).*[6]

This important experience was very important because it represented, at the same time, the stimulus and the outcome of the search path, and it demonstrates the importance of promoting collaborative activities between the academia, the specialized research centers and the companies.

In particular, the points to organize the search path are:

– investigation and optimization of the control of complex shapes that are object of study of the disciplines of Representation, aimed at the realization of Architecture, between research and teaching;
– integration of the based content of the Applications of Descriptive Geometry with the contents and developed advancements in the search field of Architectural Geometry;
– to approach enhancement through collaboration with a Fab Lab inherent in the region and/or promote a teaching program through the organization of equipped laboratories, first-level courses, theoretical/applicative training sites, workshops and summer schools.

The purpose of the research is to organize a methodological process to interpret and manage complexity through various distribution combinations of simple forms. The main academic contribution resides in graphic explanation of the existing link between the curvature of complex surfaces and the techniques of rationalization that allow us to optimize the feasibility of the architectural object.

From concept to realization, the Gaussian curvature analysis is a design tool useful to lead and to optimize the productive process of a surface. It influences the distribution of the pattern, necessary to obtain the construction of a complex shape.[7]

The simplest and most economical method for discretizing a curved surface, regardless of the complexity, is to compute and to manufacture triangular panels.

[5]http://www.medaarch.com/.

[6]http://www.co-de-it.com/.

[7]Lanzara (2015). *Op. cit.*, 11–15.

Furthermore, this method is always possible. Currently, the most geometric regular pattern used to discretize the curved surfaces are triangular, quadrangular and, in very small percentage, hexagonal pattern.

Considering the knots of a grating, to close the two-dimensional space, the sum of the angles between the rods that converge in each knot must always be equal to 360°. Only three polygons meet this condition: the equilateral triangle (60°), square (90°), and the regular hexagon (120°).[8] The planarization algorithms look for this condition. There are different common advantages between the hexagonal and quadrangular pattern, able to demonstrate their greater sustainability than the triangular pattern, including the low value of the vertices or the possibility to realize lighter structures. However, these two patterns generate some geometric limitations in the process of planarization required for the realization of discrete systems.

The hexagonal meshes represent an innovative subdivision scheme. However, it is still very little used, although its excellent properties from the structural, constructive and aesthetic point of view.[9]

In fact, hexagonal mesh is more flexible and it allow a better approximation of a given surface, compared to triangular or quadrangular tessellations.[10]

Moreover, in nature, the spread of the hexagonal pattern shows that it is also particularly stable from a structural point of view. Currently, these motivations push the studies on the optimization of discretization solutions of complex surfaces using this pattern.

However, as anticipated, the geometric regularity of the hexagonal planar panels strictly depends by the Gaussian curvature of the surface on which the pattern is distributed.

To understand and demonstrate the causes of deformation of the hexagonal planar elements, caused by the curvature of the surface, Christian Troche (2008) presented a method, called *Tangent Plane Intersection*. This method is designed to obtain the distribution of planar hexagonal mesh through the mutual intersections of planes which are tangent at the surface.[11]

If we consider a convex surface (positive Gaussian curvature) the tangent planes do not intersect the surface and the pattern will consist of hexagonal convex flat panels, which recall the known regular honeycomb structure. Contrary, if we consider a concave surface (negative Gaussian curvature), the tangent planes intersecting the surface, so the planar hexagons take the form of a butterfly.

Currently, some paneling algorithms exploit the duality between the hexagonal and triangular patterns. To planarize the hexagonal cells composed of six triangles and distributed on the surface, the algorithm perturbs the non-coplanar vertices of

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[8]De Plaisant 1987, 164.

[9]Tonelli, Davide. 2012. *Sinossi sull' ingegneria delle forme liber*e. Facoltà di Ingegneria. Università di Pisa.

[10]Tonelli, Davide. 2013. P*rogettare Involucri di Forma Libera: Ingegnerizzazione dell'Involucro*. Facoltà di Ingegneria. Università di Pisa.

[11]Troche 2008.

the cells: the goal is to obtain the equilibrium condition for which the edges of the hexagon are coplanar and the sum of the angles at the center of the six triangles which subdivide each hexagon is equal to 360°. So, this process uses the geometric condition for which the sum of the interior angles of a hexagon plan is equal to 2π. Therefore, the challenge is to search the optimal formal conditions which aim the hexagonal pattern is more regular and composed of convex elements.

The realization of the Cocoon Temporary Pavilion inside the workshop *gh to Fabrication* (13–16 May 2013) at the *Mediterranean Fab Lab* in Cava De Tirreni (Salerno, Italy), is an optimal trial to achieve this result. The *Medaarch, Mediterranean Academy of Architecture*, takes advantage from the *Mediterranean Fab Lab*. It is the first digital fabrication laboratory in southern Italy and it is a training and research center dedicated to the development of experience and studies necessary to provide new insights and answers to current challenges.[12]

The control of computational design methods allow to reach the parametric definition and construction of a pavilion, a ring structure made joining 231 hexagonal panels in corrugated cardboard. The pavilion is about seven meters wide and it is up just over three meters.[13]

The team, composed by the tutors, the members of *Fab Lab* and a group of architects and engineers,[14] has worked to obtain a discrete and self-supporting system: this property is especially challenging to optimize the production costs and manufacturing times and assembly.

The process has been divided into four stages:

Formal research, discretization/planarization of the surface, gravity tests (static/kinematic verification) and shell manufacturing/assembly.

To obtain the planarization of the curved portions in convex hexagons, according with geometric principles described before, it was necessary to perform a series of tests to generate a convex shape.

The ring surface was modeled with Rhinoceros software, positioning in space a series of consecutive ellipses. Each ellipse is placed at different height: they represent the consecutive sections curves needed to create a loft surface. The quality of all obtained solutions was confirmed by the Gaussian curvature analysis of each generated shape. The next stage involves the subdivision of the surface in the oblique hexagonal cells, performed by using the tool *Lunch Box* (add-on of *Grasshopper*—plug in of *Rhinoceros*), and in particular using the *Honeycomb patterns*, chosen between the different available paneling patterns. The number of distributed cells depends on the value attributed to the parameters u and v, correspondent to the number of iso-parametric curves which divide the domain of the NURBS surface.

[12]http://www.medaarch.com/formazione/.

[13]PicernocerasoLab: la digital fabrication sposa il cartone|*MakeTank*—http://www.blog.maketank.it/it/2013/10/picernoceraso-cartone/.

[14]Il gruppo che ha collaborato con i tutor Amleto Picerno Ceraso (Medaarch) e Andrea Graziano (Co-de-it) membri del *Mediterranean FabLab* alla realizzazione del padiglione è composto da: Arch. Emanuela Lanzara, Arch. Antonia Gravagnuolo, Ing. Amedeo Di Marco, Arch. Daniela Scovotto, Arch. Gessica Fiorillo, Arch. Alessio Palmieri.

During this stage, the hexagonal cells are regular because they are curved, then composed of non-coplanar edges. To planarize this cells was used the open-source plug-in *Kangaroo Phisics* (add-on of *Grasshopper—Rhino*) and has been used a *Grasshopper* definition, specifically developed by Daniel Piker in 2013.[15] The planarize force component computes the coplanarity of the edges of the honeycomb cells distributed on the surface. Planarity condition is necessary to proceed to the next phase of planar cutting of the panels.

It is necessary to choose a set of anchor points along the surface to maintain the shape during the planarization step and to assure the discharge to the ground of the forces through the edges of the structure.

It was necessary to study a drilling pattern of the panels to be applied to the ring: this solution allow to lighten the structure and create a permeability between the interior space and the environment.

Finally, some hexagons were eliminated at the area where it was considered necessary to open a passage. This additional operation caused different static problems, detected by *Gravity tests*, always performed thanks to the plug-in *Kangaroo Phisics*.

The material chosen for the realization of the *Cocoon Temporary Pavilion*, prototype designed for an indoor environment, is the corrugated cardboard (thickness 14 mm).

The nesting of the panels, executed with the plug-in *Rhino Nest* (Rhinoceros), has allowed to avoid wastage of material by optimizing the distribution and orientation of the hexagonal panels within the maximum dimensions of the planar cardboard panel subjected to laser cutting.

So, it was necessary to design the assembly system of the panels, represented by the creation of six special wings along the edges of each hexagon.

The pairs of wings built on the edges of two adjacent hexagons are folded and perfectly fit together.

The correct position of the hexagons is recognizable thanks to the numbering assigned to each of the elements. During assembly, this operation is essential to allow the junction of the hexagons: so it is possible to reconstruct the original shape of the shell. To manufacture the panels, milled through the use of bi-dimensional cutting technology, it has been involved a local company, the *CRTS Cartotecnica*.[16]Finally, the team assembled a prototype in the *Mediateca MARTE*, in Cava de 'Tirreni (Salerno, Italy).

This experience demonstrates that the geometry is the main instrument through which the architect consciously controls the Architecture, and certainly this discipline has always played a key role in the search for innovative solutions. The goal of this research is to translate the implicit language of mathematics and computer science through the graphic description of the geometric principles involved in the processes.[17]

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[15]Piker, Daniel. *Planar Hexagons Kangaroo: planarize_polygons.gh.* http://www.grasshopper3d.com/forum/topics/planar-hexagons-kangaroo.

[16]http://cartotecnicacrts.com.

[17]Lanzara 2015. *Op. cit.*, 115.

Therefore, the development of new approaches to teach Descriptive Geometry or applied mathematics is a fundamental goal to identify innovative solutions from the knowledge of the basic principles.

Evidently, the current trend to push projects to a high degree of formal complexity needs targeted teaching programs and deep knowledge of advanced and basic geometric principles, of which only part are traditionally taught within the Descriptive Geometry and Architecture Design courses.

University and schools are communities which necessarily interact with the wider social community: they must represent an environment of concrete and participatory experiences, a place where it is possible develop concrete solutions to answer concrete needs.[18]

However, in this context, trials or experimentations are often random and entrusted to the attendance of workshops followed by students which are particularly interested, or sometimes they are organized by teachers thanks to the collaboration of doctors and doctoral students which are able to manage some processes. The goal is try to contaminate the traditional teaching with the use of these new tools, mainly to test their potential and stimulate usage. The described experience prove that the most productive experiments take place under the second-level education, in doctorates, and often become specific research themes that offer attractive opportunities at the conclusion of the course. However, a changing society requires the ability to search for new solutions. Problem solving is the most suitable activities for educational purposes, because it allows the student to acquire the habit to provide concrete answers to the problems by enriching their knowledge and skills looking for integrated solutions. Therefore, we need to develop solutions in line with the possibilities and needs of our time. The goal is to encourage an active absorption of content, aimed at achieving concrete products.

In this context, academic research and educational activities play a fundamental role. It is important to encourage the growth of the student, as a future professional and as a subject of reciprocity and relations. He should be able to acquire the necessary skills to actively participate in the dynamics of social reality, which certainly need of integrated and multidisciplinary approaches.

This requirement encourages the creation of scenarios of academic world enriched with workshops and laboratories, places to organize equipped areas of co-working and co-fabbing and where theory meets practice through an alternation of ways, techniques, instruments and materials, working on some specific topics.[19]

So, the aim is to achieve an organization of knowledge addressed to directly respond to the real problems, promoting a more concrete relationship between knowledge and social needs.

The medium could be a process of integral formation, where the notional joins concrete experience.

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[18]Cfr. Kilpatrick [1926] 1953.

[19]Avalle and Michela 2012.

The activities promoted by this approach must have the defined purposes and should be realized through the project design stages: operational planning (definition of the problem/teaching/learning), execution (construction) and the final judgment (innovation/expansion of knowledge).

This process moves from teaching approach to application and collaboration.[20]

Among the currently active initiatives at the DiArc, i *Cantieri di Architettura* are incubator of tasks related to Architecture in its theoretical and practical aspects and they are addressed to the students enrolled at the various active university courses. The purpose of these initiatives is to enrich the training process of students through activities that complement the official courses, creating greater permeability between academia and the professional world. The activities are organized through educational activities and organization of meetings with professionals and practitioners in the field of Architecture and Design, through visits at construction sites and specialized laboratories.[21]

Innovation does not come only from the knowledge of new technologies, but above all from the ability to share experiences, techniques, the necessary machinery, ensuring the development and dissemination of the achieved results.

The proposal is to introduce in the academic world the growing reality of the Fab Lab, known laboratories based on approaches and collaborative technologies.

It is interesting to underline the important link between tradition and innovation and also reflect on the link that can be established between these realities and the ancient laboratories: at different times, these always represent some important knots for the local economy of a region.

Therefore, the combination of Fab Lab and Universities is an important opportunity that allows students, future professionals, to approach in a concrete and conscious way to the working world.

In addition, the development of research laboratories, based on cooperation between academia and business, promotes an approach aimed at the growth of the entire territory.[22]

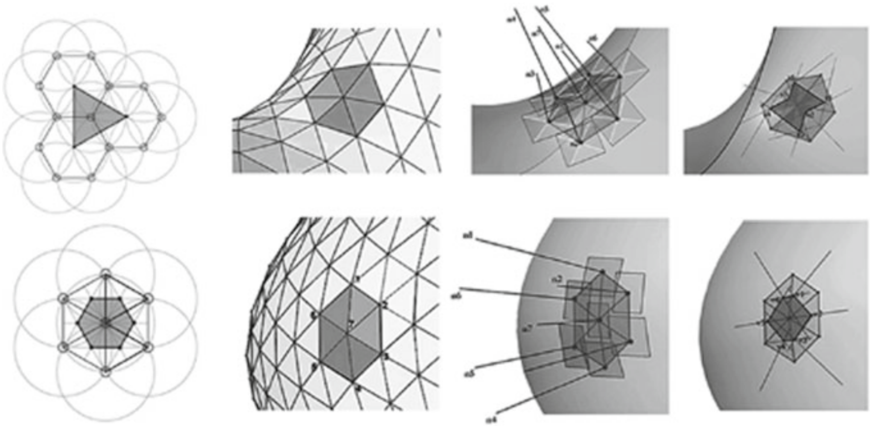
For this purpose, throughout the country, the Fab Lab are promoting training programs for schools.

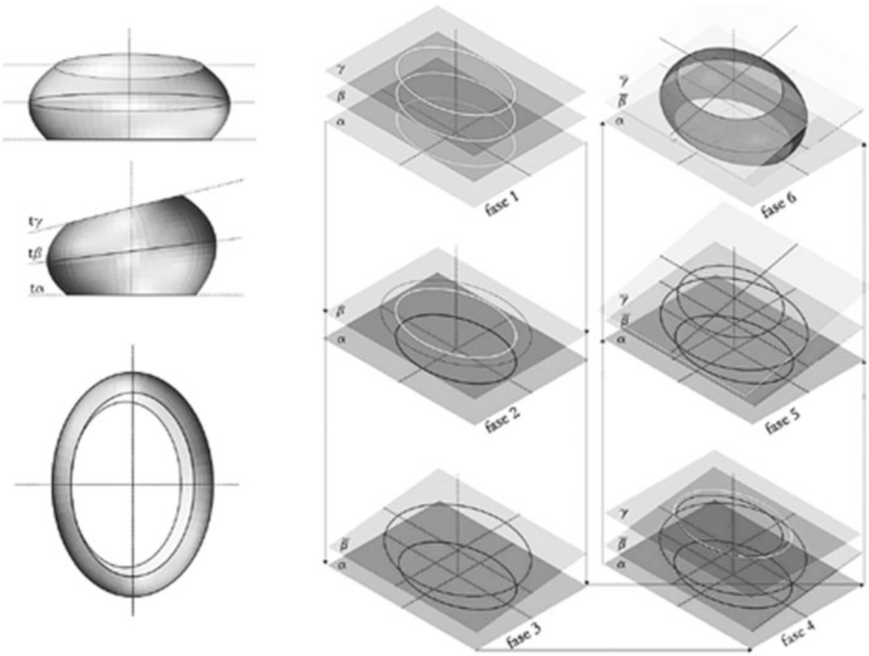
Therefore, the possible collaboration with the research and teaching worlds is an important source for the development of new professionals and job opportunities.

[20] *I Cantieri dell'Architettura*—http://www.cantieridellarchitettura.unina.it/.

[21] Cfr. Kilpatrick [1936] 1962.

[22] *FabLab a scuola: il progetto*—http://www.fablabascuola.it/il-progetto.html.

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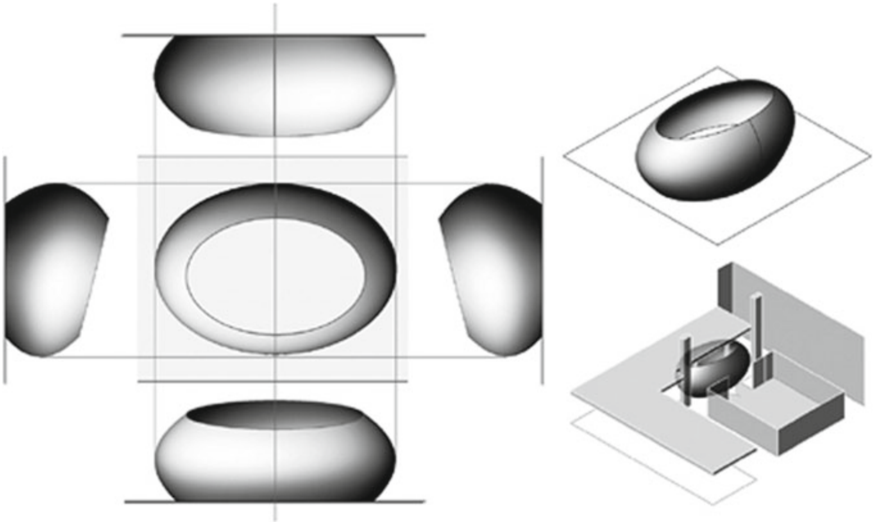
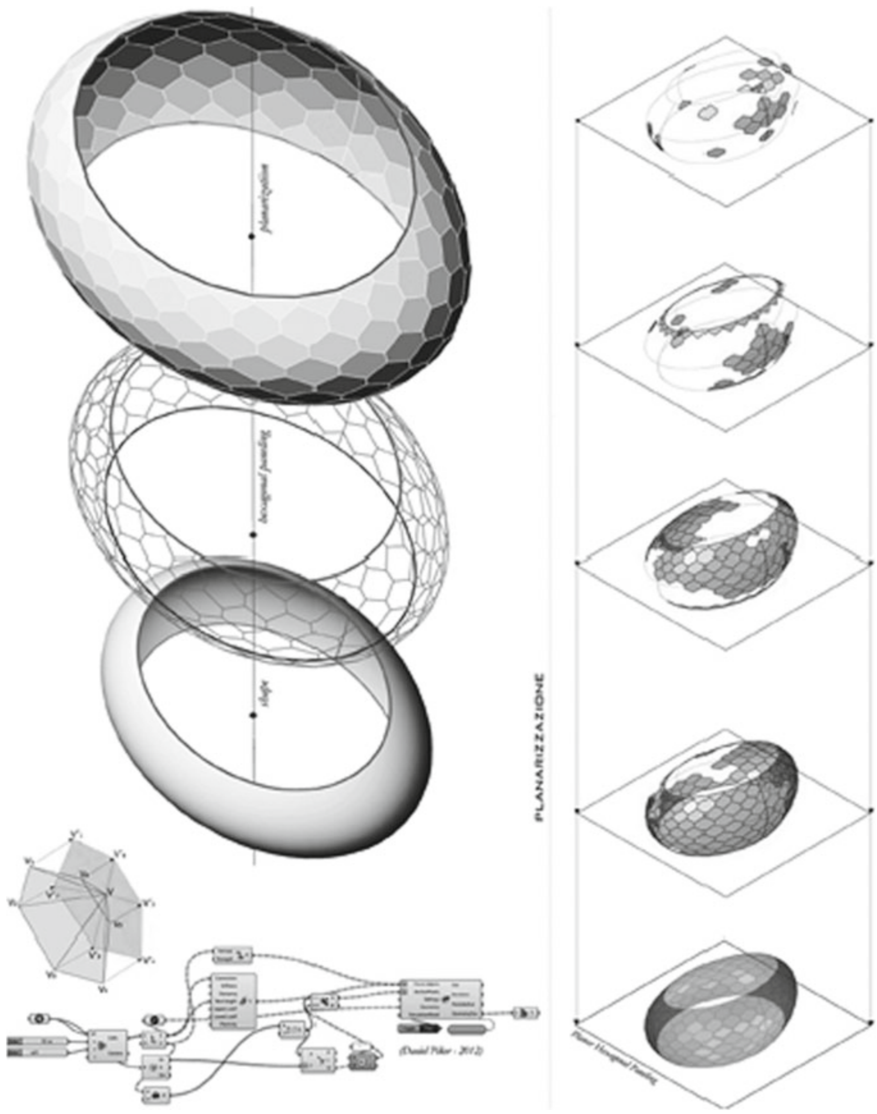


In addition, the goal is to evaluate the possibility of entrepreneurial use of the results of these innovative research and of these collaborative experiences to promote the eventual creation of academic spin-offs and start-ups, able to provide job opportunities to graduate students and postdocs which are investigating the potential of digital tools in various fields, such as advanced architectural design, new manufacturing processes, ecological urban strategies, complex systems, data management, and the future of cities in terms of energy and social sustainability.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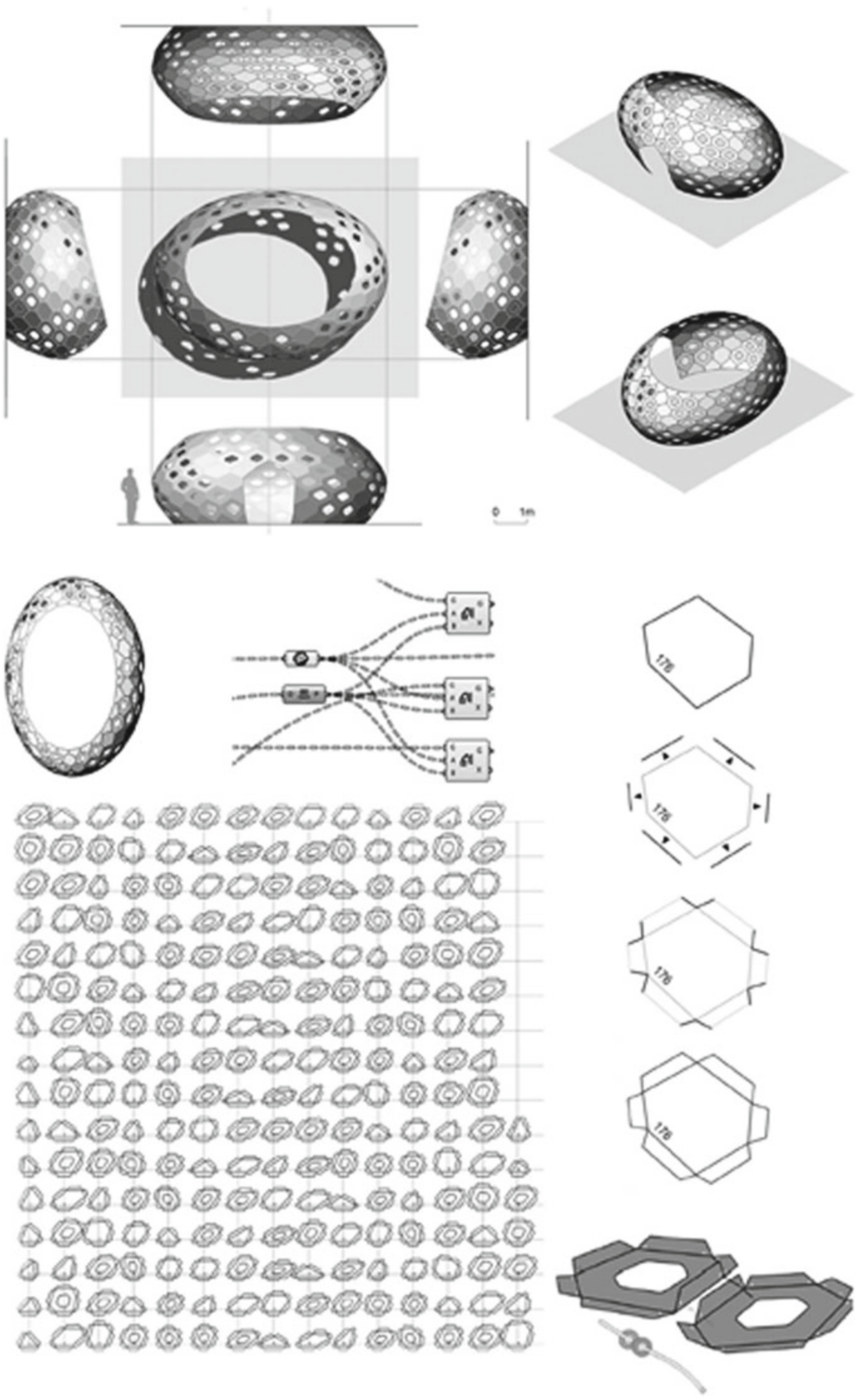
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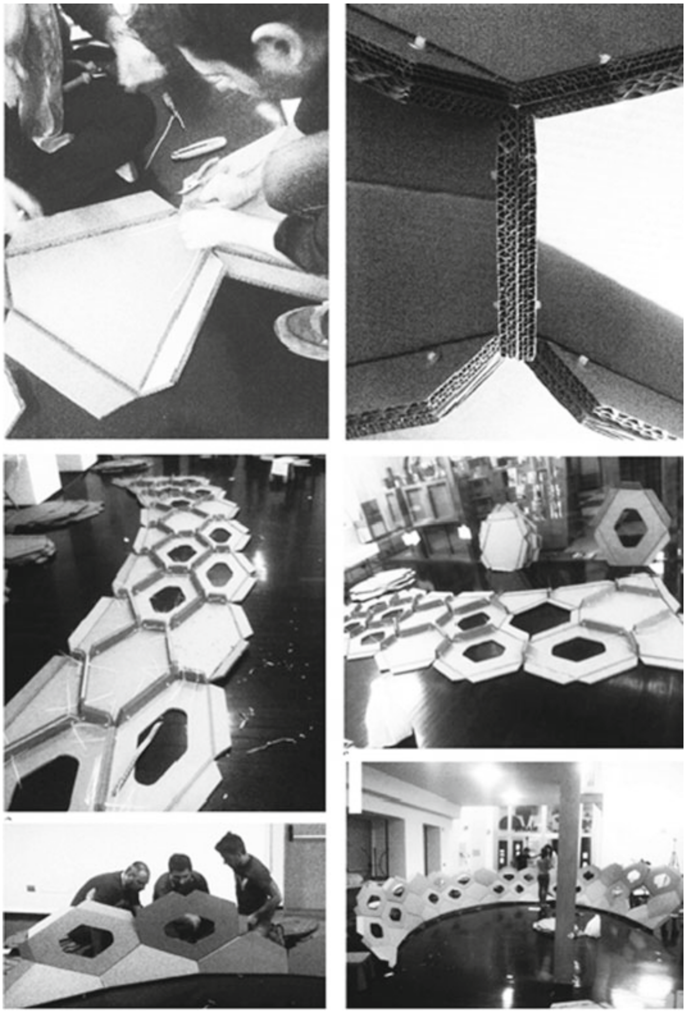

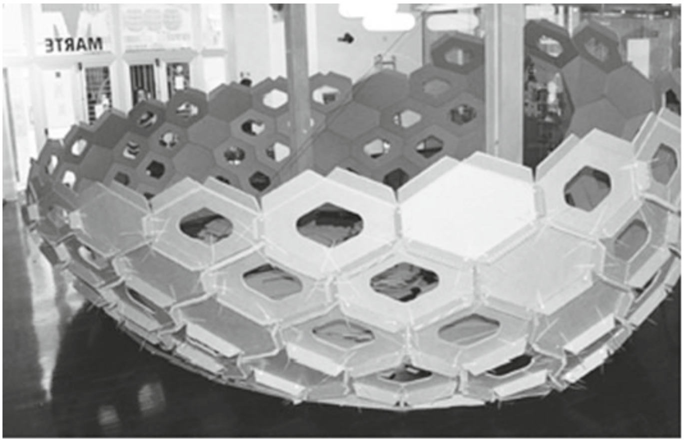

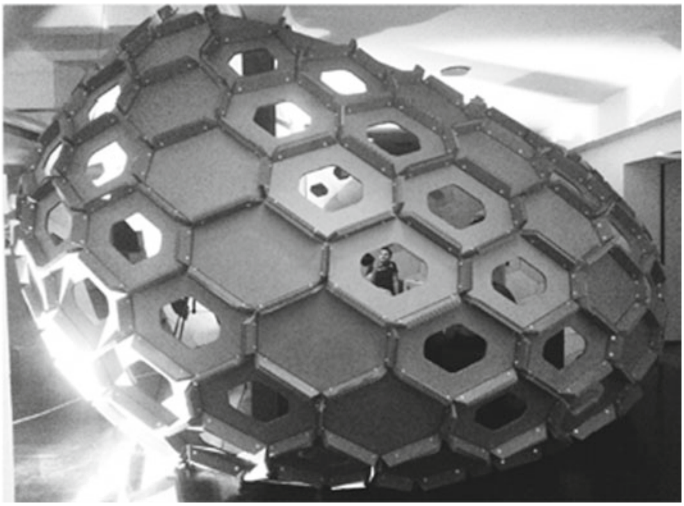

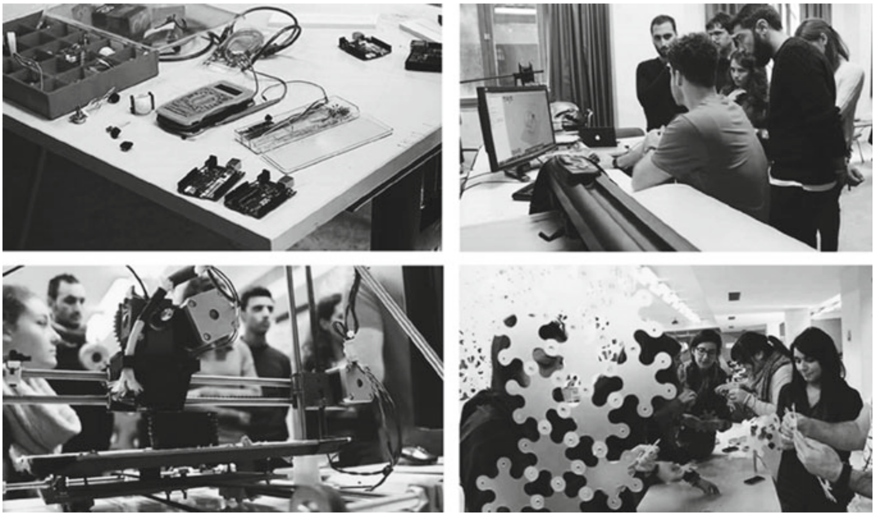

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Architectural Graphic Expression not Drawn: A Digital Approach

Pau Sola-Morales, Josep Maria Toldrà, Josep Maria Puche, Josep Maria Macias and Ivan Fernández Pino

Abstract Architectural Drawing and Architectural Graphic Expression (EGA) are well defined and known disciplines. But there are forms of architectural expression (such as photography or diagrams), which are not necessarily "drawings". In the last three decades, digital technology has offered architecture multiple forms of expression (digital photography, vector models, CAD), and has proposed multiple forms of structuring and organizing data (data modeling techniques, associative data models, database systems, etc.). The arrival of these data technologies to graphic expression requires the need to look at architecture from the point of view of data.

Keywords Architectural graphic expression · Drawing · Diagram · Representation

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1 Introduction

Architectural Drawing is an ancient discipline that has accompanied construction probably since the beginning. It serves architects to express their thoughts—especially those related to architecture—and to communicate them to others (Sainz 1990). During its long history, particularly since the Renaissance, at which time it is formalized with L.B. Alberti (Carpo 2011), the architectural drawing as a discipline has been well known, well explained and well defined.

More contemporarily, Architectural Graphic Expression (AGE) has been configured as a knowledge and production area, not necessarily coincident with *drawing*. In this second case, explicit reference is made to the *expression*, and not only to the system of representation (drawing). In the past the means of expression of architectural ideas was reduced to drawing and painting, and also to scale models.

But today there are several forms of architectural expression that are not necessarily drawn: we refer to photography, collage, video, and also to diagrams, very fashionable in recent years (Bertola Duarte 2014). We can consider that most of these forms are "graphical" in the sense that rely on visual perception of elements that resemble or are assimilated to the elements of reality, and an association or analogy occurs in the eye (Hoffman 1998; Bertin and Barbut 1968).

But not every expression of architecture has a "drawn" or "representational" base: the diagram (and partially the map) does not necessarily have a representational or homothetic similitude to reality. From different disciplines (logic, philosophy, semiotics, sociology, etc.) the idea of the diagram has been proposed and constructed as a "predecessor" of thought, and a facilitator of cognitive activities. This is true for authors like A.N. Whitehead, Ch.S. Peirce, B. Russell, M. Foucault, G. Deleuze, etc. In the latter case, the diagram "does not work to represent, even something real, but constructs something real that is yet to be, a new kind of reality. It is not, therefore, out of history, but always 'before' history, at every moment in which it constitutes points of creation or potentiality." (Deleuze and Guattari 1980) And this matter has not gone unnoticed in the discipline of architecture.

Montaner (2014) makes a wide chronology of the use of the diagram in architecture, from its theoretical foundations to its operational uses, and through the theoretical development of diagramatics in postwar architecture and the 1960s. Many authors (Sperling 2004) have suggested that, at present, the *diagram* and architecture are closely linked, and this is achieved precisely through digital media. According to Montaner (2014), "today, abstraction expressed in diagrammatic systems, despite its ambiguities and limitations, is an appropriate instrument for an initial knowledge of reality and creation (…)". While Montaner does not give a precise definition (this seems precisely to be the problem of diagrams: they elude definition), we read over his text that the diagram is a good mechanism "to interpret vectors, phenomena and desires of reality". He also refers to Peirce, who defines it as "an icon that makes intelligible relations, often spatial, which constitute a thing."

The importance of the diagram in architecture can not be underestimated. It operates in two divergent mechanisms: in the first sense, the diagram functions as a mechanism of creation and mediation in the design process (Sperling 2004). In its second meaning, it is an abstract reconfiguration of a series of information events and thoughts, “a highly abstract, synthetic and schematic way of presenting cognition or apprehension of a problem, phenomenon or object” (Bertola Duarte 2014). Or put another way: a kind of “image of thought”, a concept taken from the thought of Deleuze.

Beyond the *diagram* idea, which we will recuperate later in this text, we propose the term “representation” (which is no stranger to the AGE and the architectural drawing), or “architectural representation”, to refer generically to the expression of all or part of an architectural element, without emphasizing its final visual form. “Architectural representations” therefore include architectural drawings and architectural graphic expression forms, but also diagrams and data-based systems.

2 The Importance of the Data Model

In the last two or three decades, digital technologies have offered to architects new forms of data-based representations which have only just begun to bear fruit: digital photography, vector models in two and three dimensions, drawing computer assisted BIM, associative models, generative systems, etc.

Although these end up, in most cases, materialized as geometric shapes or “drawn” forms, close to architectural drawing, the captured or obtained data are stored “internally” in different formats, in digital systems and networks (the *Data Model*, see below). We must therefore distinguish between the display of data and the “internal” and “original” structure (so to speak) in which data is stored. Think for instance in the display of a three-dimensional model on the screen of a computer, which is nothing more than a momentary re-creation of a graphic stemming from an internal data structure (Manovich 2002; Mitchell 1992).

To provide a 100% digital system to document and represent buildings, we must reinterpret the methods of expression (graphical or else) from the point of view of digital data models: there will be no computer—or digital graphic expression—without data, and no data without an underlying structure.

Digital technologies have their origin in mathematics, and have therefore placed special emphasis on data types and ways to structure and organize information. At the lowest level, the data is of integer or real *type* (in the case of numbers), a character or a string of characters *type* (for text). These types (and some others) are the smallest units of information: grouped into more complex assemblies, several heterogeneous types can create data structures (see Fig. 1).

These data structures are defined prior to their use: through a process of abstraction (or elimination of superfluous detail), the designer decides which data are necessary and which are expendable, foreshadowing the final form of the information. In addition, this data can be interrelated in various ways, depending on

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Texto (50 caráct.)	Propietario	Juan Sánchez
Num.Entero	DNI.Numero	46249937
Carácter	DNI.Letra	R
Entero (10 cifras)	Num.Cuenta	0201234528
Entero(4cifras)	Oficina	326
Real (2 decimales)	Saldo Euros	270,78
Fecha	Fecha saldo	12/09/2014

Ejemplo de tipos y datos en una "Cuenta Bancaria"

Type	Definición	Valor
Texto (25)	Nombre	Juan
Texto (50)	Apellido	Sánchez
Texto (250)	Dirección	c. Comercio 23
Texto (25)	Ciudad	Granada
Numero (5)	CP	18015
Entero (9)	Teléfono	958342788
Texto (100)	Email	jsanchez@google.com

Ejemplo de tipos y datos en un "Contacto personal"

Fig. 1 Data types examples

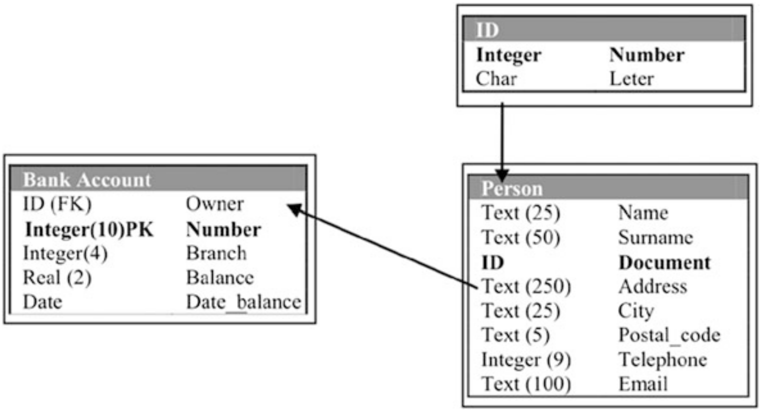

Fig. 2 An example of complex relationships among data structures

the design and the use to which they will be devoted. These relationships between data structures are also part of the definition of complex data structures, to put them in contact with each other (see Fig. 2). This process of defining data types and their relationships is called *data modeling*, and is of a vital importance in the digital world (Silberschatz et al. 1997; Hughes 1991).

Once the data model has been so defined and codified, can then the data (and only then!) be stored in a database. The database also has a predefined structure and relationships, which is merely a physical implementation of the data model explained above (Fig. 3).

Accordingly, and as mentioned above, the details of any domain must be structured for their use in a digital environment. And this is also true in the field of data related to architecture (digital representation of architecture).

In the field of AGE, so far, the digital expression of architecture has had a largely graphic expression. It is the case of the well-known computer-aided architectural design or CAAD: in it, the internal (digital) representation of any architectural element is abstracted out of its geometry, decomposed and modularized, and each part or module converted into digits [the first two basic principles listed in Manovich (2002)]. In the worst case, that geometry is just a set of simple and low

Num Cuenta (PK)	DNI (FK)	Oficina	Saldo	Fecha_saldo
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0201234789	35676633-S	2345	3.434,34 €	21/12/2015
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Fig. 3 A "data-base"

level data structures (lines, points, arcs, planes), with little or no relationship between them; in the best of cases, architecture will be represented by more abstract and complex structures (walls, doors, windows) with a certain association among them. This is the case of modern BIM systems. Starting from this geometry, there is a "transcoding" [fifth principle in Manovich (2002)], i.e. the ability to convert data from one format to another, this time over as a graph, which will be displayed on a "raster" device such as a monitor or a printer. However, what we finally "see" or "perceive" is nothing more than an architectural representation based on data, and converted into geometry: lines, points, planes, surfaces or solids.

As we see, much of the visual intelligence that architects have dedicated to representation is used to determine the geometry (shape) of architecture (March and Steadman 1971; Damisch 1994; Sainz 1990). The architectural drawing has a strong base in the geometric drawing, but in the process of architectural design—or representation or "*rilievo*" (Docci and Maestri 2009)—we generate numerous and heterogeneous information pieces, equally important for the understanding of the represented element. We generate qualitative information, such as color or temperature of a room, or the amount of noise from the street. It is true that these variables are often captured by different systems (analog, digital or mental, such as memory), and converted into number and unit. But there is in them a qualitative character that is lost in measurement [the fifth principle in Manovich (2002)]: the ability to convert data from one format to another.[1] Also, we are able to relate elements that in geometric drawing are not united: building elements linked to construction details provided by the manufacturer and available in a catalog; photographic examples of ideas or suggestions; annotations in travel diaries; various forms of inspiration; notes on the construction process; etc. In other words: the cognition or apprehension of a building is much richer, more complete, more complex than what we usually deliver on paper, and especially in digital data models that have been dedicated to the representation of architecture. These data models are clearly too poor or insufficient for a holistic knowledge.

Also, the history of a building is inseparably linked to its author and its context; to the circumstances in which the building was commissioned, planned and carried out; to the subsequent amendments; and to all the circumstances and contingencies it has suffered in its use and ownership. All this information is often left "in the

[1]See the discussion about intensive and extensive variables in Deleuze (1966) and the intelligent comment in De Landa (2002).

pipeline", lost in the drawing by the inability of our systems to represent and capture them. Geometry is too analytical and too abstract to give historical, cultural and semantic meaning to the representations of buildings. In this, geometry hides a problem behind its appearance of absolute intelligibility, and this is especially true in what is called "the initial phases of the design"—or the conceptual phase—in which the non-geometric data are much more abundant.

But it need not be so: the computer provides plenty of systems to collect, to "capture" and to link and associate heterogeneous data. Through a proper data modeling process architecture could be easily represented in a richer way, more expressive, and more comprehensive (Sola-Morales 2014).

3 A Proposal for Working with Data

In the School of Architecture at the URV (ETSA), in collaboration with the Catalan Institute of Classical Archaeology (ICAC) we are rehearsing more advanced ways to represent, manage and disseminate architecture, through a clever combination of data models and diagrams. Taking some existing architectural elements and drawings of them, we can complement the latter with all kinds of qualitative information, especially relational.

This is not a diagram in the sense that it is not a generative device [as referred to it in Bertola Duarte (2014)] from which multiple solutions can be derived (or "actualized"): the representation we propose has the characteristics of a medium of representation or expression.

The method used is not unlike that of rilievo architettonico (Docci and Maestri 2009), although the means and instruments used are different:

1. First, we studied the object and data field in which it is inserted. We discover what information is relevant to better represent the object, and list it on paper. We also try to understand the history, structure, shape and the vicissitudes of the building through comprehensive documentation.
2. Based on these initial observations and knowledge, we decompose the work on a number of variables and a set of relationships using the method of Entity-Relationship Diagram (E/R diagram) (Chen 1976) and its extended version (Teorey et al. 1986). The EER diagram generates a proto-data model, easy to implement in a relational database (Microsoft Access in this case, for ease of use and access).
3. After the initial definitions (which already take into account necessarily the knowledge of the object) we proceed to data collection. This is the most laborious part of the process, and representing more effort. Geometrical data (dimensions of space, etc.) are collected through traditional survey and with the use of topographic and laser-scan stations; other data is manually collected through observation and in situ completion of cards, which are subsequently incorporated into the database; graphic information comes from photo shoots,

and help explain some of the visual elements; finally, other forms of “data” are associations between data types and values that are manually entered based on the information available, so establishing *relationships* between data, from observation and understanding of the user, gives semantics richness. This is the analytical process of a research project, but the same methodology can be applied to architectural restoration or maintenance activities, emphasizing to the creation of assets or heritage management tools.

4. The last step, no less laborious but resolute, is the visualization of data collected by one or more graphics or graph software. In this case we use different options, but above all Visual Understanding Environment (VUE) and PAJEK. An initial ignorance of what the software can render makes this implementation a kind of discovery process, which seeks the way, the “language” (so to speak) that makes the graph better explain the architectural element, and in a most rich way. Depending on the capabilities of the software, we can add photos, text or items to each node of the element (see Figs. 4, 5, 6, 7 and 8).
5. As a final step we evaluate the result and, as a consequence, do several iterations of steps “4. Viewing” and “5. Evaluation”, until satisfactory (visual) results are reached.

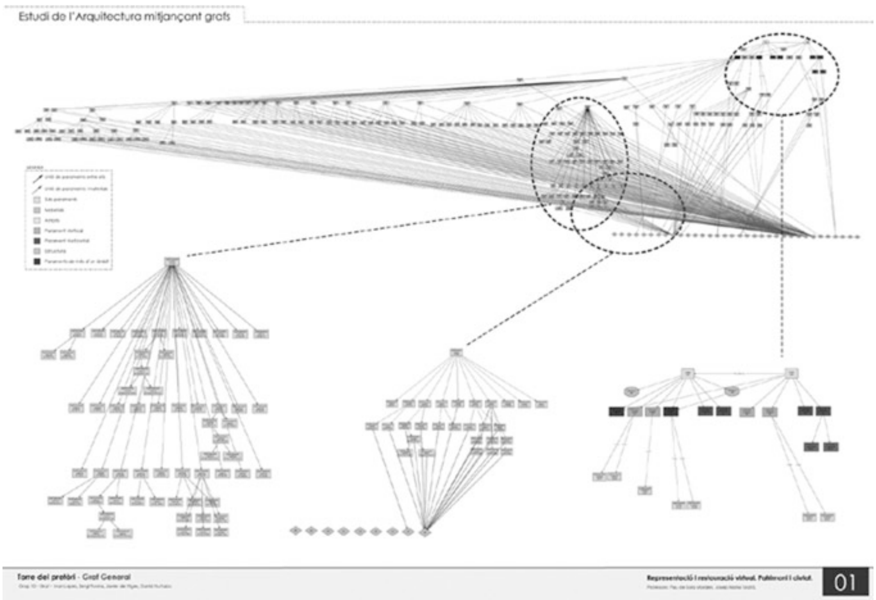

Fig. 4 Stratigraphical diagram of the Tower of Pretori

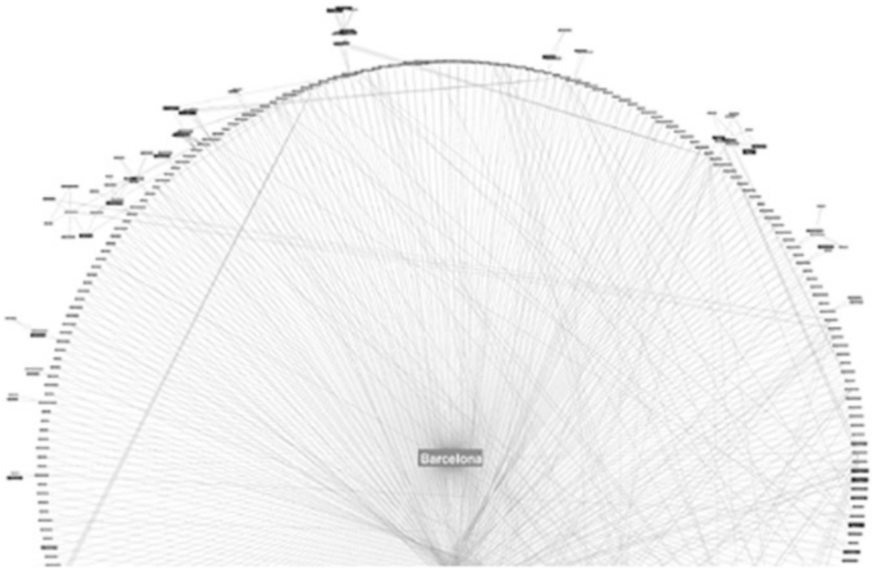

Fig. 5 Distribution of buildings by place

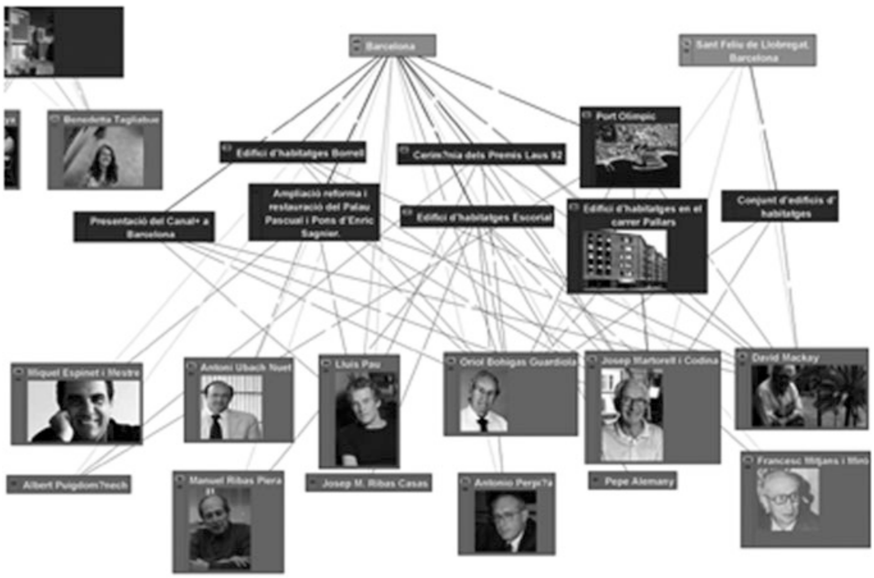

Fig. 6 “Author” photographs inserted in the nodes of the diagram

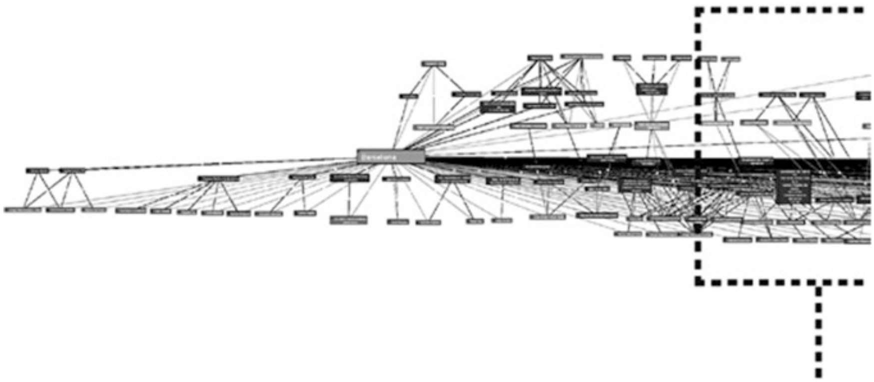

Fig. 7 Detail of a diagram

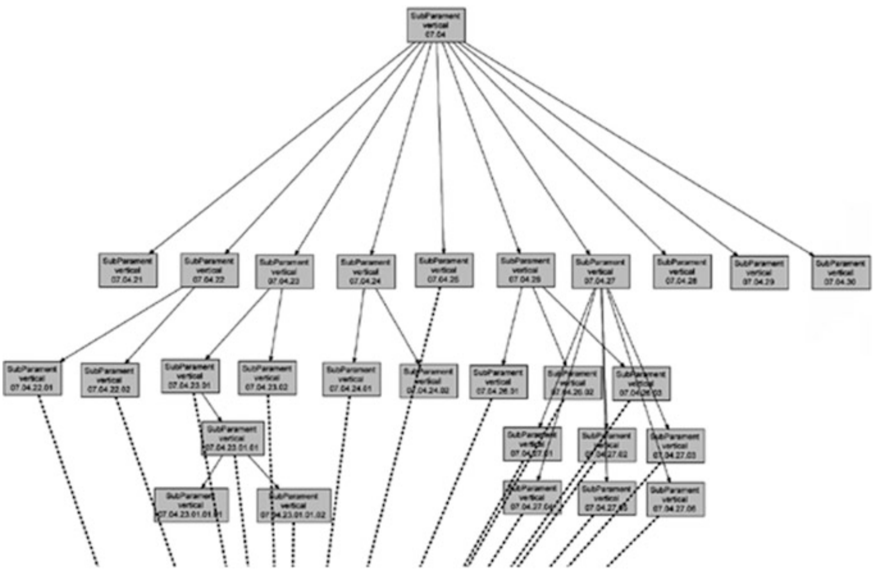

Fig. 8 Detail of the diagram of the vertical stratigraphy. Torre del Pretori (Tarragona). ETSA/ICAC 2015

4 Presentation of Two Examples of Application of the Method

In the images of Figs. 5 and 7, we have tried to represent the architectural landscape of the city of Barcelona between 1960 and 2000, showing the main buildings, and the leading architects and architectural firms (authors), interrelating with each other and with the places where they are, their dates of creation, mutual partnerships, etc.

Although the database is not exhaustive, some interesting results can be viewed from it with this method. Some of these results are trivial, such as: "most buildings are based in Barcelona" (Fig. 5). But we also discovered that some architects are central in Barcelona's architectural discourse of the post-Franco era (Fig. 6). Although this is a well known argument to the architecture historians of the Catalan capital—and to anyone who knows the context of contemporary architecture in Barcelona, the graphic display or the indirect discovery of this phenomenon out of raw data is not as clear. That is, the proposed method "draws" or shows diagrammatically—as was expected, some non-geometric, non-quantitative concepts that would otherwise only be retained in the memory or be expressed in text, ¡but not draw!

In the other case presented (Figs. 4 and 8), the building of the Roman tower of Pretorio, in Tarragona (Spain) was taken as an example. The tower has been documented by the ETSA and the ICAC in successive campaigns between 2008 and 2015. The building, now a museographic space belonging to the History Museum of Tarragona, is actually a stairwell between the Roman circus and the representation square of the former headquarters of the Roman province, reused as a medieval castle, with many contemporary restorations (Vinci et al. 2014). The end result is a cubic structure of 29 m long and 23 m wide and high, incomprehensible to the public due to its long history.

Students of the ETSA undertook a laborious data collection process, akin to vertical stratigraphy, well known to archaeologists in the sub-discipline of Archaeology of Architecture. This method consisted in using cards and photographs to document each and every walls and sub-structures of the building, and in particular its relative location (A in B, B in C, C to D, D with E, etc.). Although accurate geometric features or their exact topographical location was not known, the walls can be described with absolute independence of it. This description is based on its material composition, relative situation, technical characterization and temporal location.

5 Discussion and Conclusions

The collaboration between architects and archaeologists has proved very positive: each has contributed its know-how and methodologies and knowledge was exchanged. We recognize that there are many and very complete software packages for 2D and 3D CAAD in the market for the representation of architecture based on geometry. With this innovative method of representation focused on data we can approach architectural visualization without depending entirely on the geometry of the object. We have seen how it is possible to express some features of any architectural object—including geometry, and make descriptions thereof beyond its form and the traditional forms of representation (based on the drawing). Furthermore, we have shown how it is possible to enhance the representation of architecture, adding information (data) and relationships between the pieces.

In both cases presented, we have found some difficulties that must be appropriately explained. Out method results in a tedious job, with no possible automation: as a novel method, we need to create data structures ourselves, and this entails a lot of time. Data collection, for the same reasons, is slow and complex to organize, but probably no more than other data collection systems (such as market research). What is clear is that we do not have (yet) an automated data collection protocol, and that means a certain dispersion of efforts. In the archaeological case, the objective is to rationalize the extensive descriptive databases in its diagrammatic application (Pizzo 2010).

So the result is slow but full of hope, as some features of the buildings can be "seen", as expected, that were not present in the geometric drawing, and the stratification of its representation, which mimics the relative sequence of the architectural work.

Besides, the used method and the diagrams obtained result interesting and promising, but the visual results are more difficult to understand. Specifically, we found that the architectural drawing (the "traditional" geometric pattern) is so ingrained and so well established that crossing over the cognitive barrier with the diagrams we are proposing is a great intellectual effort, even for the AGE specialists themselves. Even, some of these specialists so strongly assume that the geometric drawing is "the" means of expression of architecture, that they are not quite ready to accept a change.

In the more material and operational aspects, we have found that the software used is too generic and not specifically designed for this purpose. For this reason, it does not necessarily respond to our data structures as we hoped, but makes its own graphic assumptions instead. This involves a process of trial and error, and thereafter an adjustment to the characteristics of the software, which only serves to further complicate the visualization process.

This very preliminary experience is promising, and encourages us to continue exploring ways of "network" representations, that is, based on data and displayed in graphs. It is important that we consider the continuation of this research in a more structured way, without the haste in which we have been in this "exploration mode". We will have to continue to investigate this system of representation with other data sets of different types, to understand in which areas the sets lend themselves to data representations and interesting displays. We also have to investigate whether we can detect patterns that repeat over and over again, which could be abstracted in "features" or "attributes" or "characteristics" of the data. We believe that we can find them.

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A List of Immeasurable Exercises to Draw

Miguel Guzmán-Pastor and Ana González Uriel

Abstract Johannes Itten noted that *freeing and deepening the expressive ability of students is the teacher's most difficult task*. Recovering the children's joy of simply trying implies avoiding a fear of failure. We present a catalogue of suggestions aimed at exploring ways to express graphically ideas and sensations seemingly without any direct relation to concrete forms. By "immeasurable," we mean both without restraint as well as without any visual referent to be measured—as in compared—against. Many of these practices are linked to the artistic avant-gardes from last century; more than a few are older; and some come from Eastern cultures.

Keywords Immeasurable drawing · Improvisation · Inventory of actions

Johannes Itten, in a publication about the Bauhaus preliminary course, noted that "*freeing and deepening the expressive ability of students is the teacher's most difficult task*" (Itten 1967).

In what follows, we present a catalogue of suggestions aimed at exploring ways to express graphically ideas and sensations seemingly without any direct relation to concrete forms. By "immeasurable," we mean both without restraint as well as without any visual referent to be measured—as in compared—against.

Recovering the children's joy of simply trying implies avoiding a fear of failure. That is why these kind of exercises—based on our own experience—help both the shy student to give flight a try, as well as provide the expert one with new ways of stepping out of their comfort zone.

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Many of these practices are related to those of the artistic avant-gardes from last century; more than a few are older; and some come from Eastern cultures.

Although we have grouped them under categories, we intend these to overlap; and we picture a back and forth of lines, traces, and brushstrokes flowing from each to one another.

We don't intend the exercises in this list as an introductory method for architectural design, nor as a way of obtaining suggestive or thought-provoking results per se, but rather as part of a larger process of personal exploration and development.

1 Proposals Related to Improvisation

In academic tradition the "all of a sudden" tests were connected to ability at craftwork. In the second half of 18th century painting prize competitions announced by the Real Academia de Bellas Artes de San Fernando included an exercise of this kind and with a duration of two hours, in contrast to the six months given for the "thought over" exam. A mythological, biblical, historical, allegorical subject was proposed. A drawing done in pencil, sanguine or watered-down, on the same type of paper for all the participants, was executed simultaneously in spaces set up for this purpose (Azcárate 1994).

Kandinsky (1912) defines *improvisations* as a gender: "expressions, mostly unconscious and often suddenly drawn up, of intern facts." It is no longer a test of skill but an opportunity to let the "vibrations of the spiritual process" flow.

Improvising refers to celerity. Quickness of execution as a premise. Georges Mathieu pushed the boundaries of this idea with his stunning works, many of them developed on large formats and in front of an audience. The most famous was in 1954 at The Sarah Bernhard Theatre in Paris.

Etymologically improvisus relates to unseen/advised beforehand. Nevertheless jazz musicians improvise around a previously known theme (standard) and without a prefixed length of time. Ornette Coleman, saxophonist who recently passed away and who rewrote the language of jazz, asserted during an interview at the Bonnaroo Festival in 2008: "Everyone gets a different feeling from improvising […] I don't call it composing, I've been calling it sound grammar, and more technically I call it *Harmolodics* […] a contradiction between harmony, movement and melody" (Coleman 2008) (Fig. 1).

Ruth Zaporah, creator of the Action Theatre (similar to our Physical Theatre), states: "When I am improvising, I know what's going on but I'm not thinking about it. There doesn't seem to be room for thought. By thought I mean the activity of self-conscious "I." […] My mind/body merges with action, and action merges with mind/body. The self-conscious "I" that analyses, categorizes, distrusts, doubts, fears, envies, etc., and thus feels separate from experience, disappears. […] The improvisation unfolds through my mind/body, using it and all that it knows, its skills and limitation. It doesn't feel as if I am creating anything. Instead there is awareness that is open and willing to be led by the event itself." (Zaporah 2002) "Dance itself is

Fig. 1 Henri Michaux, *Untitled*, 1979

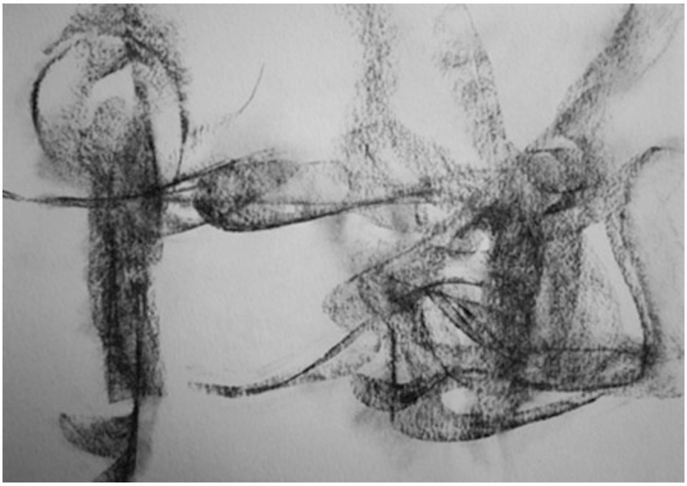

Fig. 2 Drawing by a student in front of a dance improvisation at a workshop given by the authors in 2014

thoughtless. It is its own event. It doesn't follow anything and it doesn't lead anywhere. It is not about gain or absolution. Dance dances itself and is not at all tied to the conceptual world or even the concept of dance." (Cushman 1991).

We heed the sudden and unforeseen character explained above in order to suggest quick exercises with an explicit limitation of time ("not giving time to think") and stated to some extent unexpectedly. Therefore we confirm the need for either a clear or hazy wording usable as a trigger to avoid the emergence of artificial gestures and shapes (Fig. 2).

- *In the blink of an eye*. Fill the paper taken in one breath, while we exhale slowly. Inhale. We take the air to our abdomen. Exhale slowly. As we expel the air we fill the paper with traces and stains, not necessarily many but enough of them to fill the paper.
- *Selfportrait without a mirror*. (Vicens 2013) Remember our face and draw it. After 5 min we switch the drawing implement. After 4 min we switch the drawing implement. After 3 min we switch the drawing implement. After 2 min we switch the drawing implement. After 1 min we observe the drawing and spontaneously write a short text about this experience.
- *Silhouettes*. Collective exercise. We sit perpendicular to our companion and draw the profile of his face keeping our pencil on the paper. We make several spontaneous drawings on the same sheet. Every 5 min we turn in order to switch both the angle and the model.
- *The model who draws.* Collective exercise. We sit in front of a classmate. We draw his or her full body through the modified outlines method. Keeping the pencil on the paper, we pause when necessary in order to correct the lines and complete the profile and the interior lines. This exercise and the following one are related to those proposed by Betty Edwards in her well-known best seller (1979).
- *Scattered chairs.* We choose a spot, a point of view, a framing. We draw what we see with freedom of technique. After 5 min we switch our drawing hand. After 5 min we slowly draw without looking at the paper and keeping the pencil on it. After 5 min we observe the drawing. We change our position in the space and we repeat the procedure as many times as wished.

We say “pencil” although any other “dry” drawing implement may be tried, i.e. wax, charcoal, pens, chalk, rotrings, etc.

The expression of those “facts of internal character” soon surpasses the limits of what we conventionally understand as drawing or painting. It’s the case of the North American artist Matthew Barney, who in his work Drawing Restraint I proposes an athletic action of physical resistance for which he builds some ramps provided with harnesses to which Barney ties himself, serving as resistance in his attempt to draw on both the walls and the ceiling (Fig. 3). As may be seen on the website of the project and video recordings available in youtube channel, the resultant traces respond to what is possible within the frame of the self-imposed limitations and derived from the physical conditions of the artist at the specific moment, and also from the chosen space and mechanisms adapted for this action (Barney 1978).

Of these experiences, we are particularly interested in those exploring the awareness of both our own and other bodies in relation to space. Some of the numbered exercises in the categories of collective exercise or drawing the movement will be included here.

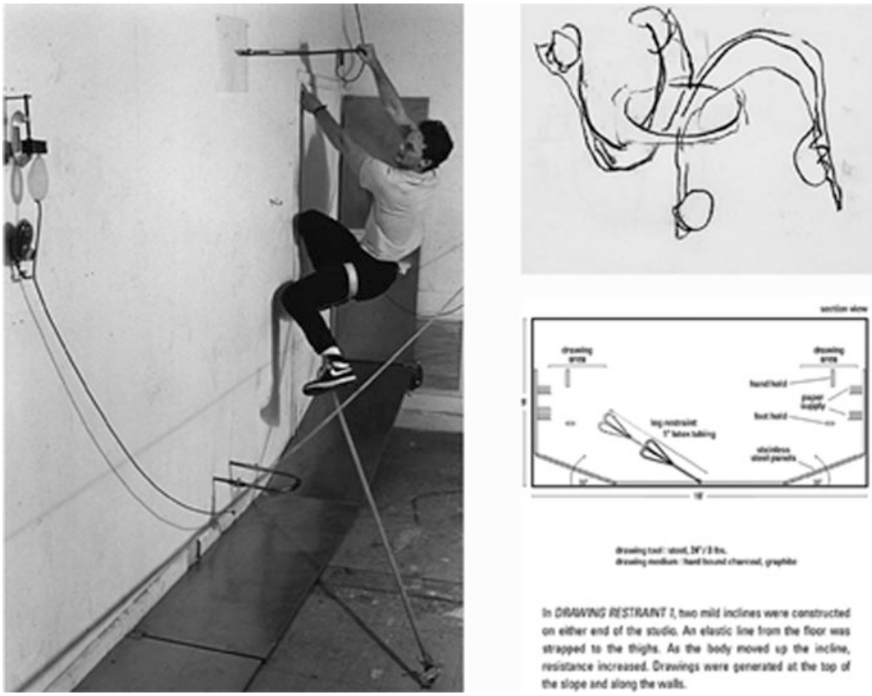

Fig. 3 Matthew Barney, *Drawing Restraint I,* 1987

Depending on available time and classroom milieu it may be useful to develop some practices on relaxation and focusing (connected to the introductory exercises proposed by Itten) contributing to leave aside our routines and worries.

2 Practices Related to Automatic Drawing

A series of exercises with no particular intention neither previous to nor during their execution.

– Trying a variety of surrealist techniques of graphical expression leading to accidental or semi-accidental drawings (Table 1; Fig. 4).
– *Surrealist variations:* Making up and combining some versions of the latter.
– Making *stunning* compositions with any “thing” (for instance to lay on a DIN A3 sheet of paper small objects found in a park or a waste ground) with the only intention of enjoying their *beauty* (Fig. 5).

We understand *beauty* as per Edmund Burke’s treatise *Ideas on the sublime and the beautiful*, written in 1756 and quoted by Juan Bordes (2006): “I have great reasons to doubt if beauty is rather an idea common to proportion. Proportion, as it

Table 1 Surrealist techniques

Airbrushing	Prehistoric technique in wich a three dimensional object is used to make a stencil with spray
Smoke printing	The prints are made by smoke on paper or canvas
Bulletism	It involves shooting bullets filled with ink on a parchment placed on stone
Exquisite Corpse	Collective assembly of a set of words or images drawn on a paper folded and then unfolded (Surreal game of *consequences*, 1925)
Liquid dropping on a vertical surface	To create images by dragging any liquid or allowing it to drop on a vertical surface (Origin in Romanian surrealist group)
Calligramme	A written poem, phrase or word where typography, calligraphy or handwriting create an image (Guillaume Apollinaire)
Collage	To paste glue pieces of images on a cardboard or a table, resulting a a entirety
Coulage	Automatic or involuntary sculpture made of liquid or melted material (metal, wax, chocolate) poured into cold water
Cubomania	Method for creating collages cutting an image into small squares and then randomly reassembling them (Gherasim Luca)
Decalcomania	Spread some black gouache on a paper, then press it onto another paper and take it off before the paint dries (Oscar Dominguez)
Dream résumé	Similar to an employment résumé but based on achievements, jobs, etc. imagined in in a dream state rather than in waking life
Echo poem/Echo drawing	Drawing or poem made by two people with corresponding stanzas into two columns When finished, write the title. (Aurélien Dauguet, 1972)
Indecipherable writing	Writing in such a way that the reader can not decipher the message. (developed by Romanian surrealist group and also called surautomatism)
Involuntary sculpture	Unconscious manipulation of found objects, like i.e. unrolling a ticket, bend a clip, etc.
Étrécissements	Cut some fragments of images and then dock them in a new one that will look distorted. (Marcel Mariën, 1950)
Photomontage	Composition made of several photos or illustrations, resulting a final photograph. (Henry Peach Robinson, 1857)
Frottage	Rubbing a pencil or graphite mine on a sheet placed over an object, obtaining an impression of its shape and texture.
Entopic graphomania	To draw points in areas of impurities in a paper and then draw lines or curves between points
Heatage	An exposed negative is heated from below, causing an emulsion that randomly distorts the image. (David Hare)
Paranoiac-critical method	The state of paranoia allows the subject to perceive relationships between objects that apparently or logically are not connected. (Dalí)
Outagraphy	Technique that involves cutting the characters out of a photograph (Ted Joans)

(continued)

Table 1 (continued)

Parsemage	Disperse charcoal powder or pigment in water, pass a thick paper or cardboard on the water surface to skim the pigment and let it dry (Ithell Colquhoun)
Scraped off	Scrape a painted canvas with a dry paper. (Max Ernst, Joan Miró)
Éclaboussure	Once the painting (oil or watercolor) is fixed, turpentine or water is poured over and then soaked up (Remedios Varo)
Cut-up technique	Random literary technique in which a text is cut up and then rearranged to create a new text

Fig. 4 Frottage by the author, 2014

seems to occur with any idea of order, is referred almost completely to convenience; therefore it must be considered as a creature of understanding rather than a primary cause that acts on our senses and imagination. We do not find an object beautiful by paying a great deal of attention to it or investigating it thoroughly; beauty does not need help from our reasoning […] the appearance of beauty gives rise to a degree of love in us, the same as the application of fire or ice provokes the idea of heat or cold […] beauty is not a measurable idea and it has nothing in common with calculus or geometry."

– *It is the wind who is drawing:* we set a pen or very light paint brush soaked in black ink tied to a string previously tied to a branch of a tree. We observe how the drawing device operates until we consider the paper needs to be taken off and substituted. We observe the resultant series. The same exercise may be made with different drawing implements (Fig. 6).

Fig. 5 Drawing *with* nature, student at a workshop with the authors, 2014

- Invention of all sorts of drawing machines based on the action of fortuitous or unmanageable behaviour agents i.e. rain, noise, waves, etc.
- *Guided drawing*: A student closes his eyes and draw. A classmate can activate, freeze or modify the process with verbal directions: speed, angle, curve, gentle, intense, etc.
- *Remote-controlled drawing*: On ground or sand. Try to draw familiar shapes with a remote-controlled car. Abstract drawing. Parallel and perpendicular strokes. Curve strokes. Observe the outcome. Photograph the details, smooth the sand and repeat.
- *Drawing while non-stop talking*. The main part of the conscious thinking of the student would be devoted to articulating logical speech. Therefore his attention —and control—would be either partially or totally taken away from the drawing action. Making doodles while phoning is a common practice related to this exercise. We suggest working in pairs, one student does the exercise while the other listens. The listening action is essential.

Gómez Molina (2007, 38) alludes to *drawing without drawing* and brings up Joseph Beuys words: "thinking is already art … ideas have a stronger impact upon the world than art that has been begun and that in some way hasn't been materialized in the object"; and Bruce Nauman's: "Drawing is equivalent to thinking. Some drawings are made with the same purpose as writing: they are both notes we take down."

3 *Approaches Related to Collective Drawing and Authorship Dilution*

- *Collective layered self-portrait, with no mirror.* Remember your own face and draw it front-view. Every 3 min we move round, leaving our drawing and implements to the next classmate. We add a layer to the drawing we find, making our self-portrait on the previous one. And so on until we complete the circle and get back to our initial drawing.
- *Scatterd chairs, several hands collective version*. Choose a chair, sit down, frame a view. Then draw for 5 min using any drawing technique. After 5 min stand up and leave your materials on the chair. Move round. For 30 s just observe the drawing your classmate has been working on. We change hands and continue our classmate's drawing for 5 min. Move round. For 30 s just observe the drawing your classmate has been working on. Then slowly resume his work. Draw for 5 minutes without looking at the paper keeping your pencil on the paper. We move round and draw, changing technique.
- *Drawn dialogues (empathy).* Previous exercise: *Blind strolls.* A student closes his eyes. Another one holds his hand and guides the slow motion stroll through the space. The one with his eyes closed tells a story, making it up while walking for five minutes. Then switch roles. Later change classmate. Repetitions.

Drawn dialogues exercise. 1. Put chairs in pairs, one in front of the other distanced 5 feet between each other and each pair. Sit on a chair in front of a classmate. One of you makes up an image through a spontaneous and improvised narration. The other simultaneously draws the image for 5 min. Observe the output and switch roles. Repeat exercise creating the image with eyes closed. 2. Put the chairs forming a circle, facing the centre and equally distant from each other.

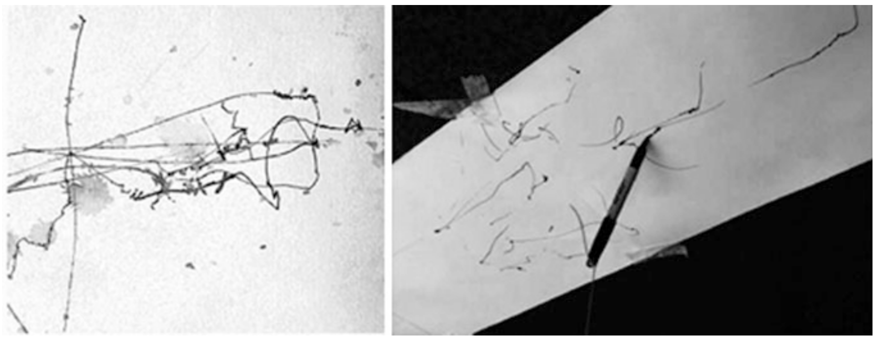

Fig. 6 Drawing of the wind and a drawing machine, students of Yeunhee Kyouung, 2011

Half of the students sit down and the other half stand in front of them, one to one. The students who stand make up an image through a spontaneous and improvised narration, moving round to next position every 30 s. The companions on the chairs simultaneously combine the images in one drawing. Until we complete the circle. Observe the drawings and switch roles.

These exercises are based on some of the workshops given by the Australian performance artist Andrew Morrish and on the basic techniques of Action Theatre created by the North American artist Ruth Zaporah.

4 Different Approaches Concerning How to Draw Movement

"Everything flows" (Heraclitus)

Long before Futurism images were produced and the approximation by snapshot overlapping techniques relating to the development of photography, Leonardo invented codes to record bird flight paths or gale intensity.

Also, in his notes he advised: "A good painter has two main goals while painting: the man and his spirit. The former is easy. The latter is harder as the painter needs to represent it through his body movements."

But movement can also be purely internal. Septuagenarian Henri Matisse on a wheelchair cut and stuck coloured papers (gouache découpées). "Sculpting in colour" with his scissors (Fig. 7). He connected this action to flying. Also to swimming, especially to his memories of plunging into the volcanic lagoons under the "golden globet" of the Tahitian sky. Some of those works, dated between 1943 and 1946, were published in 1947 by Efstratios Tériade under the title of "Jazz". By 1943 Duke Ellington recorded "It don't mean a thing/If it ain't got that swing". (Tom Philips 2014)

- *Relative movement, object:* Walk around the object. Draw—imagine the outside and also the inside of the object.
- *Relative movement (motion?), live model:* Live model static pose. Drawers walk around, changing their viewing angle, distance, frame. Make several drawings on the same paper, composing the forms within the space./The same exercise may be done in a collective way, moving round and working on a classmate's drawing.
- *Overlapping movements, live model:* The classic exercise with live model in motion could be done in combination with the one described just above.
- *Flow drawing:* Using careful observation of flows of water, crowds or animals as a catalyst (Fig. 8).

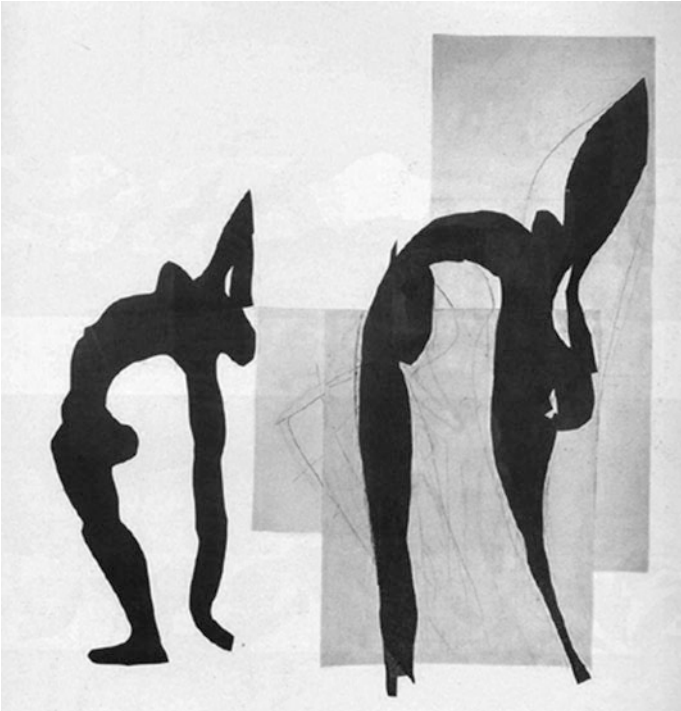

Fig. 7 Henri Matisse, Blue Nuedes, gouache découpée, 1952

5 Approaches Emerged from the Use of Literary Devices such as Hyperbole, Hyperbaton or Just Overflow

- *Kanon* versus *anti-Kanon Diptych:* Live model pose, 15 min. Draw academic style using the standard techniques, considering frame, geometry, structure, composition, volume, light and shadows. Stay in the same place. New paper. Same live model pose, 15 min. Draw freely exaggerating proportions (increase height, width, dimension of the limbs.) Once done, contrast both outputs.
- *Live model.* Three 5 min poses. Overlap the three figures on the same paper.
- *Living space.* Three poses of 5 min each. Overlap the three figures on the same paper creating a relationship among them and with the space.

In 1912, Paul Klee writes on Die Alpen review "The works of the insane must be taken seriously, more seriously than all the public galleries" (García Villarán 2009).

The word *Art Brut* was coined by Jean Dubuffet (Figs. 9 and 10) in 1945 alluding to works created by people outside of social standards: misfit, loner, aged and specially mentally ill. "I am convinced that art is here more vivid and exciting than the manifestations of bored official art even if it is catalogued as avant-garde"

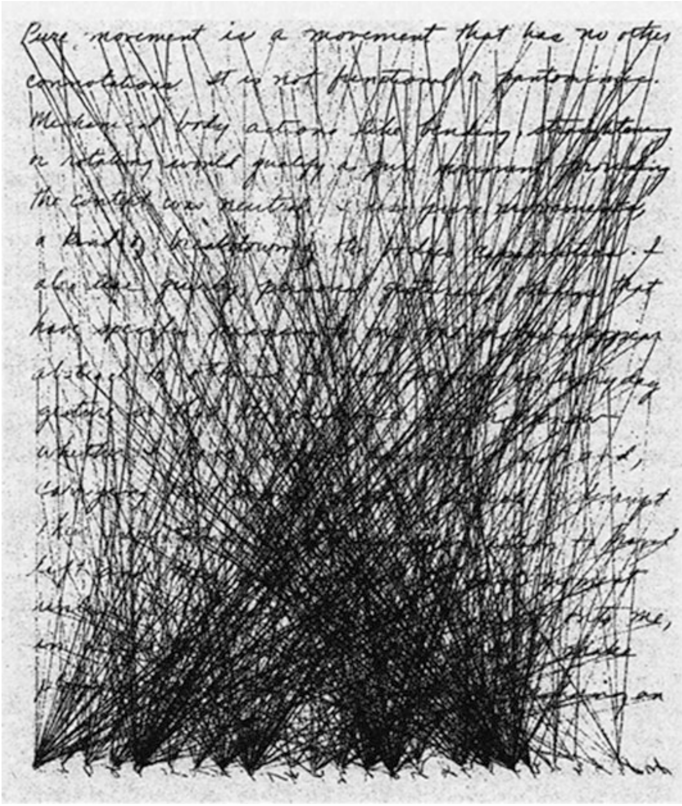

Fig. 8 Choreologic notation. Trisha Brown, 1988

(letter to C. Madame, Paris, August 9th, 1945. Archives of the Art Brut Collection in Lausanne.) The *Compagnie d'Art Brut*, in which also Slavko Kopac, André Breton, Jean Paulhan, Charles Ratton, Henri-Pierre Roche and Michel Tapié took part, gathered a wide collection of these works and set up several exhibitions.

"Personally, I believe very much in values of savagery; I mean: instinct, passion, mood, violence, madness." Dubuffet (1951).

And also, "My persistent curiosity about children's drawings, and those of anyone who has never learned to draw, is due to my hope of finding in them a method of reinstating objects derived … from a whole compass of unconscious glances, of finding those involuntary traces inscribed in the memory of every *ordinary* human being, and the affective reactions that link each individual to the things that surround him and happen to catch his eye." (Quoted by MacGregor 1989)

Art Brut leads to *Outsider Art* in English. Outside the limits of official culture, unconcerned about public, critic and market, with no other justification but freedom and creation itself.

Fig. 9 Student drawing in a workshop with the authors, *Grotesque of Statue*, 2013

Concern about art works done by mentally ill people grew parallel to psychiatry. The French doctor Philippe Pinel (1745–1826) had claimed for attention to creative activity in patients as a link with sanity. He pointed to the therapeutic possibilities of art. The Englishman John Haslam published *Illustrations of Madness* in 1810. In 1892 the American James G. Kiernan organized a conference in Chicago about the art of the mentally ill where he speaks about its similarity to primitive art (MacGregor 1989). The same year the German Max Nordau publishes *Entartung*—Degeneration—which sadly later would become a source for Nazi defamation of avant-garde art. In 1900 The Bethlem Royal Hospital holds an exhibition of patient art. In 1905, Dr. Auguste Moliere opens the Museé de la Folie (Museum of Madness), a collection of patient art at the asylum at Villejuif, France, and so does the psychiatric clinic in Heidelberg, Germany in 1909 (Jones 2010).

The Heidelberg institution is where German psychiatrist Hans Prinzhorn (1886–1933) worked from 1919 to 1921. He had studied art history, philosophy and music before the war. He expanded the earlier collection, compiling and studying more than 5000 works by about 450 patients. In 1922 he published *Das Bildnerei der Geisteskranken* (Artistry of the Mentally Ill), illustrated with examples from the collection. The book had an immediate impact and deep influence in avant-garde art scene, reaching leader figures as Dubuffet. “Our patients make contact with the deepest facts in a totally irrational way, and they often unconsciously reveal transcendental views. This way we find, in a different context, the idea of the existence

Fig. 10 Jean Dubuffet, *Dhôtel nuancé d'abricot,* 1947

of psychical expressions and object forms that, under certain circumstances, are almost the same to every man, like physiological processes." (Prinzhorn 1922).

A selection of around 120 masterpieces of the Prinzhorn Collection has recently been presented in Berlin (November 2014 to April 2015) and Heidelberg (April to August 2015) under the title *Das Wunder in der Schuheinlegesohle*—The Marvel in the Shoe Insole. "In The Prinzhorn Collection of artworks everything is possible: thick handwritings, visions of the effects of radio broadcasts on the mind, political or religious systems only understandable to the author, military plans or, as in the piece that provides title to the exhibition, the circumstances of a marvel revealed in a shoe insole." (González 2015).

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Doctoral Thesis, "Enric Miralles, the Drawing of the Imagination" Research of Creative Process Through Graphic Expression

Salvador Gilabert Sanz, Hugo Barros Costa, Pedro Molina-Siles and Javier Cortina Maruenda

Abstract The doctoral thesis "Enric Miralles, drawing of imagination" is an example of research with apply both academic and professional levels. Enric Miralles, architect of versatile expression, in which the most important and where the essence of the project is in the process of creation that is not limited to the shape or the facade and where they are never merely an end result. This thesis, analyse these graphic projective strategies and process through drawings, collages, notebooks travel and how to represent projects. A direct application in the academic and professional worlds is done, more specifically in the subject Analysis of Architectural Forms in Architecture at Escuela Técnica Superior de Arquitectura de Valencia.

Keywords Doctoral thesis · Enric Miralles · Drawing

A doctoral thesis can be an avenue of research in the field of graphic expression, specifically in creativity and designing, and should be used in both academic and professional levels.

The thesis "Enric Miralles, drawing imagination" by Salvador Gilabert, is an example of research in this direction.

Enric Miralles, architect of versatile expression, he stood out among others for his manner of projecting architecture in which he would give the most importance and where the essence of the project would be in the process of creation, that is not

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limited to the shape or the facade and where these would be merely a result of the process instead of an aim.

About his way on going towards things, he explains: “The most important is the art of initiating thoughts, the way to invent and represent things”. Enric Miralles, he begins to work the thought through drawing, combining pencil, ink, color, collage and other techniques, and being the best drawings the ones that are in the intermediate study of the ideation process.

Drawing for Enric is not only a form of expression, he goes further on, using graphic tools for the genesis of his architecture, his work is born in drawing and being a work so rich in nuances, you need all kinds of resources, shamelessly mixes because it is not a drawing to show coherence and systematization, his idea is a drawing that in its construction becomes a project.

This thesis comes to analyse these graphic projective strategies and its process through drawings, collages, travel diaries and the way of representing projects. Enric Miralles drawings are rarely representative, his main intention is creation, the uncertain time of the genesis of the work and how it develops to generate an architectural universe.

As a starting point, in addition to studying the work of Enric Miralles, it is essential to understand his writing, listening to his lectures, and above all, studying his references and his doctoral thesis, “Things seen from left and right (without glasses)” 1987 where it is possible to clarify that his thesis on the concept of travelers drawings in XVII and XVIII century, is actually a “thesis” made in the author’s way. We could say that the thesis was made in certain way to explain himself, and it appears that Rafael Moneo understood this when he wrote a review on it.[1] (Fig 1).

“And so today I see his thesis as a declaration of principles, of what architecture was to Enric in the days that he wrote it. In 1987 Enric had already reached maturity.”

Enric himself said about his thesis:

> These pages do not want to get rid of ‘Things seen from left to right’… just tell its origin… these pages tell that this way of writing down is almost a script. It is born from writing, which is mixed with writing. It has its origin in the broken writing that allows simultaneous readings of the page. That simultaneous look at the entire page, writing that comes to replace the ordinary reading, where you need to go from one end to the other by the spectacle of simultaneous word.[2]

The design method of Enric’s work, distances itself from the resources used in the world of contemporary architecture, their understanding of things is not based on the discourse of creation from a function-ideashape where form follows the function. His is a way of working from a dialogue between ideas, the environment

[1]“Un comentario a la tesis doctoral de Enric Miralles Moya, 1987” el DC. 17–18, Revista de Crítica Arquitectónica publicado en 2009.

[2]Miralles, Enric. Carta de Enric Miralles enviada al tribunal de tesis en 1987. DC. 17–18, Revista de Crítica Arquitectónica publicado en 2009.

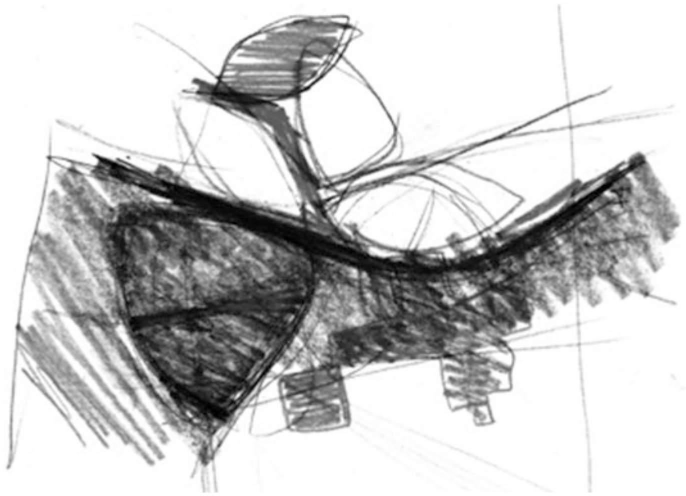

Fig. 1 Miralles, Enric. Ideation sketch for the Parliament of Edinburgh, 1999

or the place where the spatial and functional needs are not the sole reason for the project, and where they become more subjective factors such as history, culture. It is a methodology based on the open process where several factors act on defining geometry. The architecture he obtained was a result of the interaction of these mental relations, worked and elaborated in the process, never a goal a priori.

Ultimately this way of approaching the project, is based on deeper understanding of the process of creating architectures with no restrictions but the programs and needs of the project object (Fig. 2).

This way of doing has more to do with the processes of drafting workshops potential literature and art, where the work process, is architecture itself, becoming more important than the outcome itself. This creative inventiveness, Bergson calls it a "myth-making authority," which allows man ton invent realities. It is a capacity, which is often mistakenly called imagination.

By studying the artistic, literary and architectural references that motivated his way of reacting to things, you can understand certain beliefs and ways of our architect. George Perec, Raymond Queneau, Federico García Lorca, Le Corbusier, Josep Maria Jujol, Marcel Duchamp, Paul Klee, David Hockney or Erik Satie are some of its key players on which it based a way to work itself, personal and exciting.

So he nurtured from artistic sources, from the freedom of expressions that are far from the representation must sometimes work of architects. Pataphysics, theory of derive or poetry, are used resources in creativity and are essential elements.

A decisive influence was the Oulipo movement, born in the 60 s from seminars about experimental literature that eventually became into workshops of potential literature (Oulipo). It was an unconventional movement, linked to the pataphysics line that does not follow any vanguard direction. In it, the method of finding new formal structures is applied, continuing the way given by surrealism (movement in

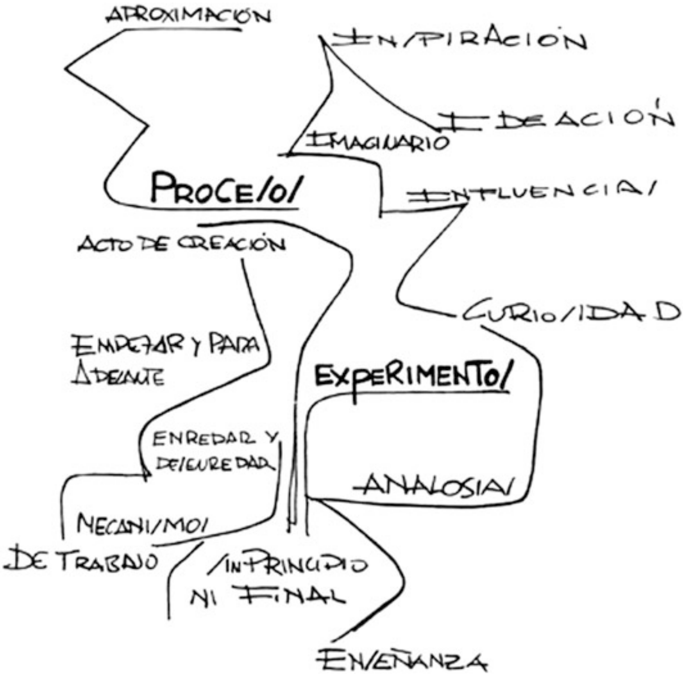

Fig. 2 GILABERT SANZ, Salvador. Outline design process of Enric Miralles. Doctoral thesis "Enric Miralles, the drawing of the imagination," 2015

which Queneau had initiated its artistic career and who moved away by disagreements with André Breton ") (Fig. 3).

The book "The Exercises of Style" by Raymond Queneau was an essential reference for Enric in understanding parallel realities and the way of approaching things…".[3]

Conscious and reasonably restrictions were applied that allowed new forms of creation, "We call potential literature finding ways and new structures that may be used by the writers as they will.".[4]

The process will unite two different disciplines, intuitive and academically, but equally worshiped by followers of Oulipo movement, mathematics and literature. So, together concepts like restriction (Semantic, combinatorial, algorithm, fractal) that used to focus his own act of creation.

Another notable influence is George Perec pataphysics with Espècies d Espace (Species of Spaces) and La Vie mode d emploi (instructions usage life), handbooks for Enric (Fig. 4).

[3]Granell, Enric. Conversaciones con Enric Miralles. Conferencia. Círculo ecuestre, Barcelona. 2013.

[4]OuliPo. La littérature potentielle. Gallimard. 1973, p 38.

Fig. 3 Carelman, Jacques. Caligram done for the first edition of "Style exercises" by Raymond Queneau (Oulipo Movement), 1963

Enric appeals to Queneau and Perec in multiple times, from variations of the same situation or to tackle a problem from different perspectives. In his office with his staff when revising his works he often insisted:

Always different!

"We are forced to do things has always differently, as one vital principle (do one thing always different ways).

Between using disjunctive or copulative conjunctions, the option is always copulate. "Si sale con barba San Antón, sino, Purísima concepción" Enric, which is not very different from what Einstein used to say… If I knew where I was going I would not call research what I do…

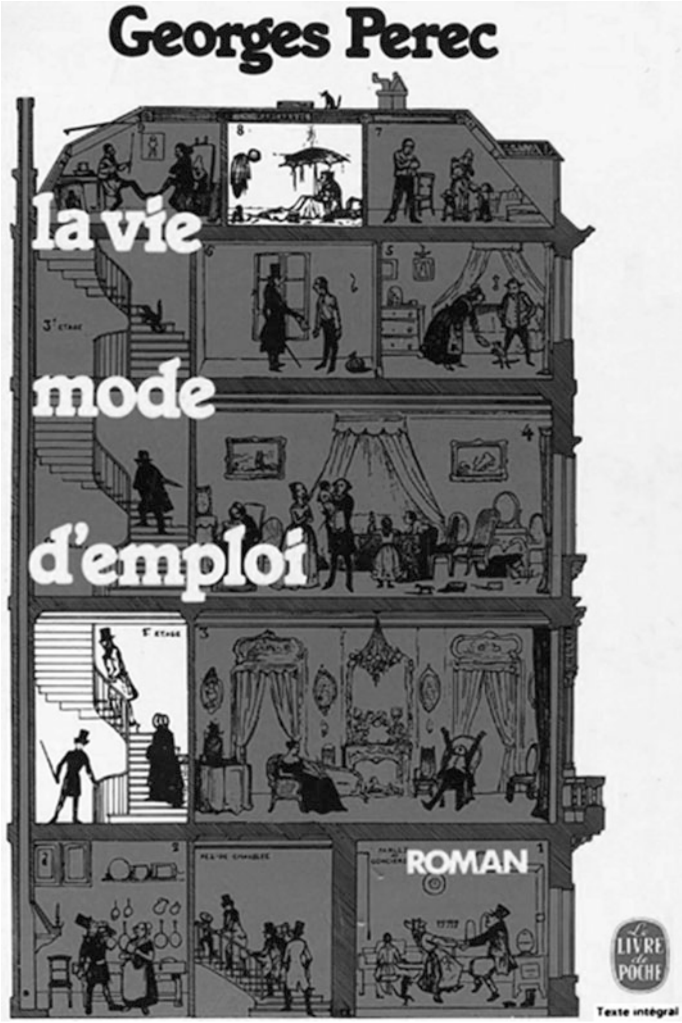

Fig. 4 Perec, George. Cover of "la vie mode d'emploi" (Life, instructions for use). 1978

In projects and in life (always alike traveling), you do not know the destination port… just thinking differently you'll do really different things.".[5]

By repeating again and again applied variants of an idea into a project, telling the same thing in different ways, suddenly a new way opens.

This way of approaching things, generated multiple possibilities and variants, created without restrictions. The executed project was just one of those intermediate

[5]MESTRE, Octavio. Espais per viu- re i trebajar. ed. L´Institut Monsa. Monografías Despaix. 2008.

states that materialized from the many options in one place and in a particular time. Actually these architectures were never finished and evolved to another place with another proposal. What it meant is that you never start from scratch, the process begun in previous projects, adapted to each new place and combined with the new network of information that shaped it. Once the proposal was materialized and built, this process continued to evolve in the following assignment and so on.

From these experiences, he developed his way of seeing things and approach to the ideas, generating a working method with which he created his own poetry in architecture.

It is inevitably to understand that the evolution in the way he drew, where thought becomes reality, affected his way to project and create in his different stages. This process of creation generated a network of relationships between the starting conditions, the place, the program, and its own symbolism full of poetry and imagination. He processed all this information to create the ideas that would shape the proposals with an obviously personal language. The result is therefore a result of the development of work, not as an imposed idea, that is why the geometries resulting from fragmented and dynamic spaces seem almost impossible to imagine a priori. These are the results of overlapping layers and layers of information that were produced and worked by means of tools. One such tool was the collage, which has the ability to integrate wide range of disparate information.

Processes that are rather mental schemes where processed through a never strict but conditioned way on each proposed project, and the information in an organized creative way, and where in need of the action to integrate and find the solution (Fig. 5).

This kind of dialogue between things, were also produced between student and teacher in the classroom, where problems from actuality where brought through statements with work processes derived from its previous research.

A clear example was the monographic courses imparted from 1994 to 1997 at the ETSAB. Three years dedicated to experiment in the approach the beginning and end of project process.

According to Carme Riva, in the conference that was held on Thursday, September 24, 2015 at the headquarters of the Enric Miralles Foundation, these courses were distributed as follows:

The first course, in 1994–1995, was dedicated to Venice, taking the project idea of the whole city as a laboratory. With Le Corbusier and his hospital project in Venice was the first influence. The course was developed with reference of the Situationist drift, which was used as a guide never thought as a way to project. Enric gave them the reference of "Situationist International anthology" by Ken Knabb and the movie "The Naked City" by Jules Dassin (Fig. 6).

The second part was spent during 1995–1996 and had as its starting point the city of Vienna and Otto Wagner with the excuse of potential literature workshop in background, where restrictions were generators of true design freedom.

Finally, the third year during 1996–1995, was about the city of Istanbul and the Grand Bazaar as the idea of overlapping layers of history.

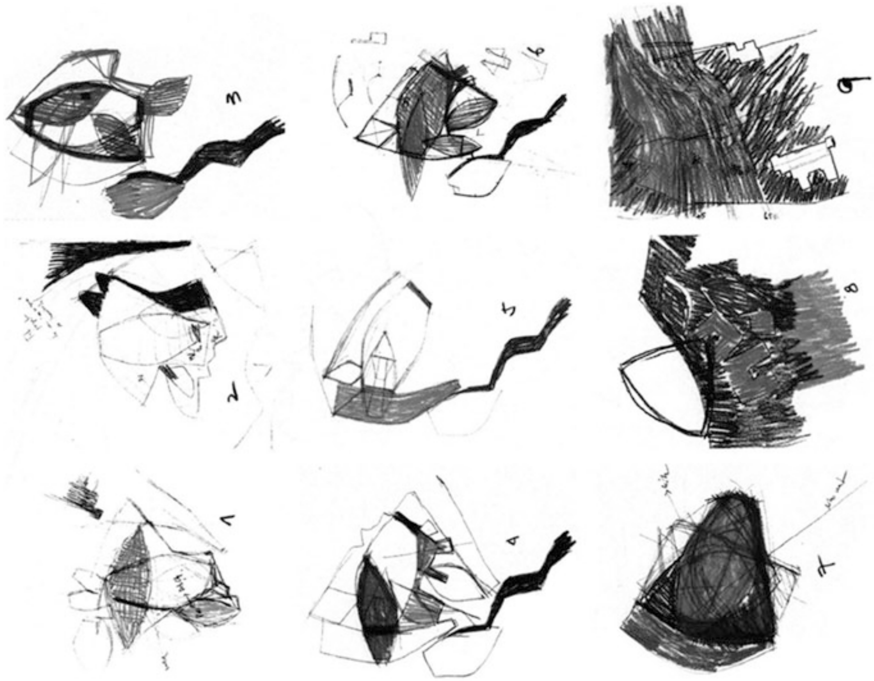

Fig. 5 Miralles, Enric. Sketches done for the project of the Scottish Parliament in Edinburgh. 1998. Archives project folder EMBT Miralles-Tagliablue loan from © Fundació Enric Miralles

Fig. 6 Guy Debord. The Naked City. 1957 (Situationist International)

Fig. 7 Photomontage workshop. "representing feelings" UPV. 2010

On another occasion Enric Miralles applied these experiences in seminars or short courses, as in 1998 in the ETSAB in Barcelona, he did a workshop based on the Oulipo to show students the great possibilities offered by this design process, at the same time as an inhibition, the most "academic" way of the profession, which is the manner universities are accustomed. "Optional Class". For this optional class, Studio IX–X of course based on the text "11 rue Simon Crubellier" by Georges Perec, where they searched to develop architecture from restriction parameters but with absolute freedom.

Education world gave him the possibilities that sometimes were not offered to him in his professional life. As Enric would explain further on:

> Pedagogy is a very important part of my job, because it is, in some way, where I am professionally freer. These things allow me; through the experiments of other people's work to update my opinion on contemporary architecture[6]

Research and experimentation realized where highly contrasted by our author in both real life and with his students. They experimented and learned with him, it was a feedback relationship that moved him towards something new.

"… The academic world and the real world can be connected, in the most positive aspects: the independence of judgment, in generous reasoning about things, or simply in the possibility of open experimentation." N7.

These investigations and prosecutions conducted by the architect who transformed the way of understanding architecture in the second half of the twentieth century, are synthesized in the research realized in the doctoral thesis "Enric Miralles, drawing imagination" of Salvador Gilabert in 2015 and who after drafting conclusions applied them directly in both professionally and academic life, more specifically in the subjects of Architectural Forms Analysis and Architectural Graphic Expression coursed in the first and second year of Architecture School in Valencia since 2010 (Fig. 7).

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[6]Miralles, Enric. Entrevista, MASSAD, Freddy. Arquitectura como sentimiento Revista Summa + Número 30. Argentina. 1998. pp. 90–95.

In addition to the application in the work of graphic expression of collages as a means of superposing graphical information that adds value to the drawings by hand, or compositions of the sheets as architectural and artistic value in itself, there have been workshops such as “blind drawing” 2012 or “draw music” in 2013 and workshops such as “representing feelings” at the UPV, 2010.

With these experiences and after checking the results with freshmen students, and closely observing their attitude before and after the exercises, 95% of all the cases were obtained as a positive reinforcement on the rest of the contents of the subject. Students explained their happiness upon being free from the restrains from

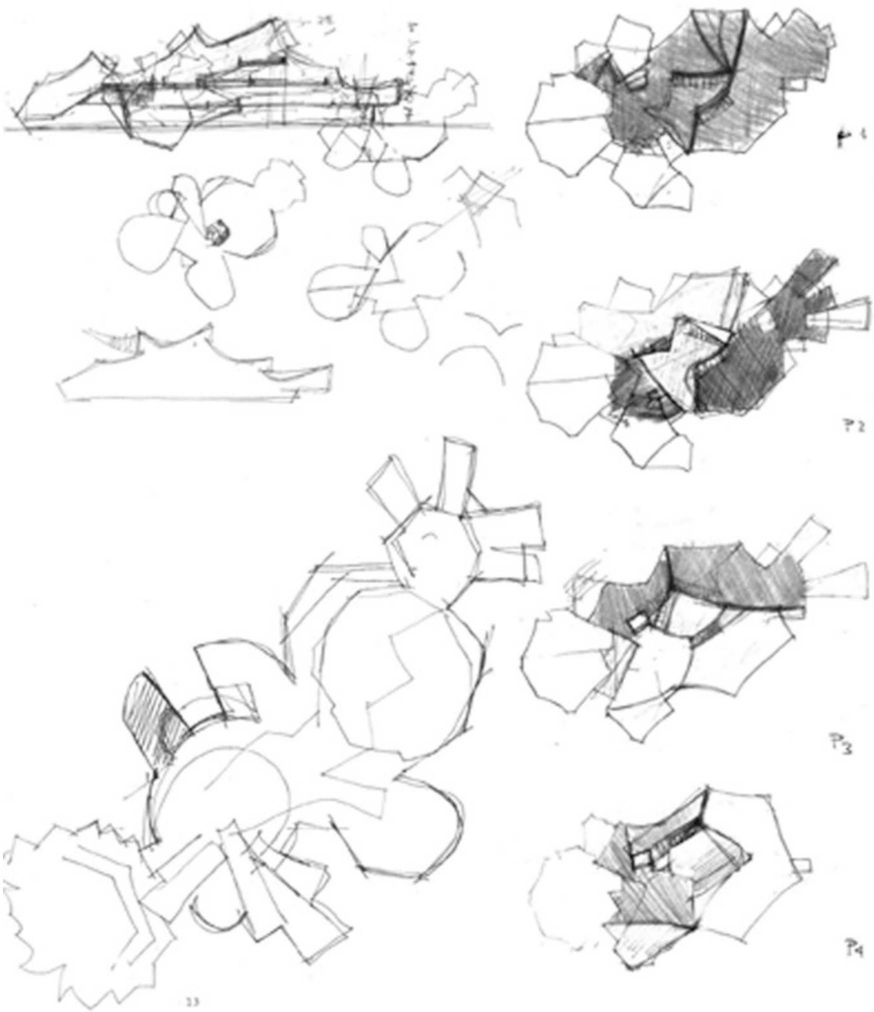

Fig. 8 Gilabert, Salvador. Drawing conceptualization in the Doctoral Thesis “Enric Miralles, the drawing of imagination, 2014 (Sketches for the competition of a library in China. 2012)

drawing by hand again and again with exercises every day in Architectural forms Analysis assignment produced by the usual exercises, (another essential part of learning how to draw and conceptualizing architecture).

In the passing of the years, students have experienced literally “creative freedom” that has instinctively led them to express their most personal and daring ideas. This has led them to appreciate more the last course by better understanding and assimilating much more routinely exercises needed as the most experimental. He has also managed to relax the disciplinary tension caused by slower progress in favor of more freer and personal actions. Complementary to those who draw most effective way, it has provided them to open to a new world of creative possibilities not so common in this stage of learning architects.

We can understand the impact of certain investigations as Enric Miralles’s own or the ones that have been made about the same in both the work and professional world as well as in academic and teaching.[7] (Fig. 8).

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[7] Miralles, Enric. Entrevista con Enric Miralles, Marismas, Quaderns. 1992, pp. 18–21.

extension of Diagonal Mar Park in Barcelona. As his own projects he has done diverse bio-climatic buildings and is in the process of research within the European sustainable development programs for 2020, Climate-KIC program.

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Example of a Blog as a Research and Academic Toll About Drawing

Hugo Barros Costa, Salvador Gilabert Sanz, Pedro Molina-Siles and Javier Cortina Maruenda

Abstract The blog *a fresh drawing everyday* started in a classroom, 5 years ago, when I suggested my students doing a drawing every day. After the general answer “that is impossible”, I proposed uploading a daily drawing in the web, so they could check if it was possible. Since then, I am sketching every day and posting a “fresh” drawing at this blog, alternating them, occasionally, with some old sketches. Starting with black and white sketches, color has instinctively started being protagonist in this illustrated and personal diary that reflects my personal and academic life and the evolution of drawing on it.

Keywords Blog · Drawing · Diary · Communication

1 Introduction

The academic and personal blog *a fresh drawing every day* (www.hugorc.wordpress.com), was generated in a classroom in 2010 after proposing the students of the subject Analysis of Architectural Forms to make a drawing every day.

As a result of the general negative response from students who, terrified, almost in unison, invoked the impossibility of such a task, I proposed the publication of a series of daily drawings through the future blog, created at that time, in order to prove that such work could actually be possible.

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2 The Blog

Given the continuous difficulties of communication with the students (concerning the basic concepts of the above mentioned subject), another—and equally important—goal of the blog *a fresh drawing everyday* was the attempt to create a communication channel teacher/student, as a strategy teaching. That is, since the traditional ways of communication were not working, we thought that the web could be a better way to approach to students.

Consequently, an exchange of drawings (teacher/students) was also proposed through the blog, subsequently allowing comments and questions on-line.

Although this exchange with the students was not as fruitful as expected, it remains an involvement of personal research on Drawing, which has been extended to other subjects and teachers of Graphic Expression and other means of representation such as the laser-scanner.

Thus, although the main materials used to feed the blog are usually “traditional”, no door is closed to digital tools, either in the execution or in supplementary processing of the drawings.

Since this is a communication channel dedicated to Drawing, it also features occasionally news, videos and images from different artists.

3 The Process

One can research on Drawing by two means: studying the works of others (in libraries, museums, archives, exhibitions, web…) or through their personal process drawing, i.e. theoretical or empirical knowledge. We are not arguing that these activities are independent, since to develop our personal drawing is essential to learn from the others.

For this purpose, internet, as just mentioned, is fundamental, as it allows us to visualize every day, through groups such as the Urban Sketchers, thousands of different drawings on a global scale. Here, comments on techniques, materials, among other issues, leading to a direct or indirect communication with a very large universe. Recently, I had the great pleasure that, in his nineties, Czech architect Yona Friedman, commented some of the drawings presented in the blog.

Also, this research through the drawing, has been complemented (in parallel with the doctoral thesis of Hugo Barros costa) with the physical and virtual visit to numerous files, such as Bibliothèque Nationale de France, Library Riccardiana in Firenze, Portal of Spanish Archives, Archives Moma, Archives of Cooper Union Art School, Torre do Tombo, Vatican Archives, OAC (on line Archive of California) or UCSB (Santa Barbara).

However, the main element that feeds this research is a result of the experience to test multiple scenarios through (literally) thousands of drawings where have been experienced materials, compositions, viewpoints, climatic conditions, developing the ability to interpret reality translated by personal codes.

As we write these lines, five years passed by since the first drawing was published in this blog. We find this material enough (or too much, considering the reduced limit of the article) in order to perform a (summarized) effective analysis of its basic content.

The content of enables detailed information (statistics, tags, categories, comments, etc.) relative to the introduced entries, providing relevant data for this analysis.

4 What Is Published

The content (excepting a few entries reintroduced from other *blogs*) is totally made by the main author of this article.

They are divided into two big groups, the academic and the personal.

The academic content is related to the subject Analysis of Architectural Forms, that is one of the most visited subjects on the Blog.

1182/Maison Carré—Alvar Aalto//Geometry (172 views) http://wp.me/pLtki-1YV
1233/Archaeological Museum in Vitoria/Alava//Spain (141 views) http://wp.me/pLtki-236
1241/Analyzing the Archaeological Museum in Vitoria/Alava//Spain (136 v.) http://wp.me/pLtki-23C

This content is destined to support students by providing didactic materials for each proposed exercise in class. They are simple examples or visual references that aim to support the drawings executed by the students. This implies an effort of the teacher who must perform all the drawings requested to students, but also allows him to be prepared to support students in eventual questions relative to the proposed exercises, once he has had to overcome the same difficulties from own experience.

Relatively to this topic Frank Ching says: “When teaching, I am forced to articulate the reasoning for what I normally would do in an instinctive and intuitive manner. Teaching requires that I explain in a very short time what I have gained through many years of practice and experience.” (Costa and Hidalgo 2015) (Fig. 1).

In this “Academic Content” I also included drawings done for my PhD thesis, *History of the graphical representation of Castle Peñiscol*a, *from graphite to laser*, some of them published in this *Blog*.

Although the laser scanner was the main graphic tool for architectonic survey and representation basis of this thesis, the use of various types of sketches contributed to better assimilation of the studied object. We believe that the direct contact with the subject is still fundamental, along with traditional field notes and data reference. They are, in our experience, essential when drawing in CAD the cloud points generated by the laser scanner. Unlike the laser beam, whose only criterion is to measure the distance to the first object it finds in its path,

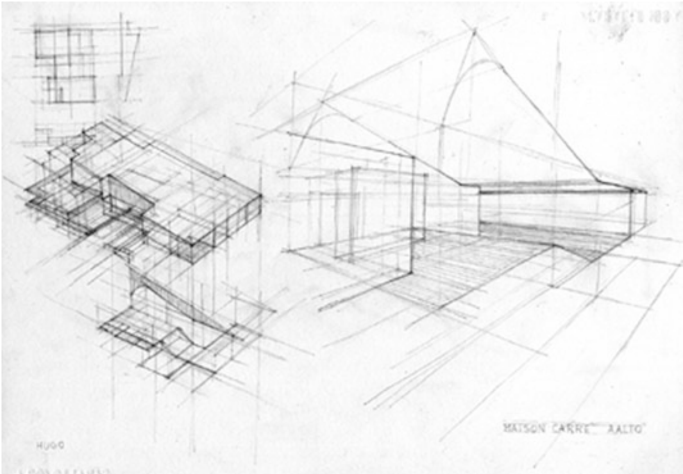

Fig. 1 Hugo Barros Costa. Analysis of architectural forms (subject UPV). Analyzing the complex geometry of the Maison Carré

Fig. 2 Hugo Barros Costa. Laser scanner point cloud. Peñiscola Castle. Castellón

“field sketches” are conducted in accordance with specific objectives and criteria oriented to a certain purpose of the survey, which, although personal, makes them very analytical and selective regarding the required information.

The method of working with this tool, that can quickly identify millions of points, exemplifies how digital tools can be integrated with traditional ones. Thus, in developing this method of field work/processing of digital data, we have found, paradoxically, that the supports of traditional records, starting as simple schemes of

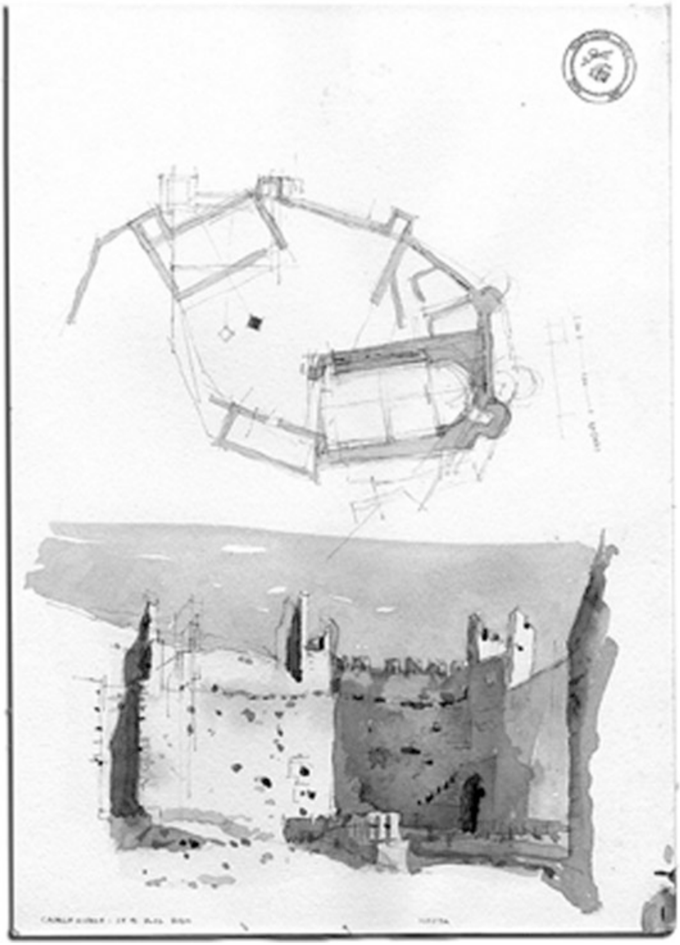

Fig. 3 Hugo Barros Costa. Plant and perspective. Graphite and watercolor. Xivert Castle. Castellón

scanner location, were increasingly supplying us with valuable information of shapes, colors, materials, details …

These drawings, in parallel with the unequivocal effectiveness of the scanner, question where and how the digital accuracy need mental and physical support of the traditional drawing. We must accept that it is possible to perform such architectonic surveys without the support of the drawing, however, we think this is a complement that increases informative and analytical value to geometric analysis (Fig. 2).

The second large group, *personal drawings*, can be classified into 5 main categories (architecture, travel, people, events and a last one, harder to specify, which I would define as *living or urban atmosphere*) (Fig. 3).

5 Architectural Drawings

Architectural drawings, are highly represented in the Blog and are undoubtedly the most viewed:

11/Therme Vals*Peter Zumthor/Graubunden//Switzerland (1890 visitas) http://wp.me/pLtki-1x

45/Boa Nova tea house*Siza Vieira/Leça da Palmeira//Matosinhos (1096 v.) http://wp.me/pLtki-4y

117/MAC-Niterói/Oscar Niemeyer//Brasil (1086 visitas) http://wp.me/pLtki-am

These *Post* are mostly accessed through search engines (Google, Bing, Yahoo …), indirectly, by users that seek information about the architects and works related to the above mentioned drawings.

6 Travel Drawings

According to the conclusions of the last International EGA Congress at Gran Canaria, whose main theme was *Architects Travel Drawing*, this field "is a vast field of study within the Architectural Graphic Expression" (Figs. 4 and 5).

In the same text is also stated that "The *real travel* and graphic recording has been a constant activity of the architect throughout history…". "Regarding the travel drawing in the architectural education, the link between the action of travelling and drawing remains significant and recommendable to students, either incorporated into the academic curriculum and as an individual activity of the student."

My personal *real travel* and respective graphic record were for years the main motivation for the practice of drawing. Travel activity is a pause and abstraction of everyday life; it keeps the senses awaked and opens the door to new perceptual discoveries. It is remarkable to note how differently two individuals can understand and represent the same space.

In addition, the impressions that are recorded in the memory, after the drawing process become part of our personal cognitive baggage, which most likely would be lost by not being registered.

Since drawing every day, my amount of travel drawings have been gradually reduced, relatively to all the total records made. I do not want to say that I draw less on travel, but that everyday drawings are obviously the most frequent.

7 Drawings of People

These sketches made in public or private spaces, in static or dynamic situations allow me to more easily integrate characters in the subsequent drawings of urban environment. They are usually made in small format and allows me to quickly test

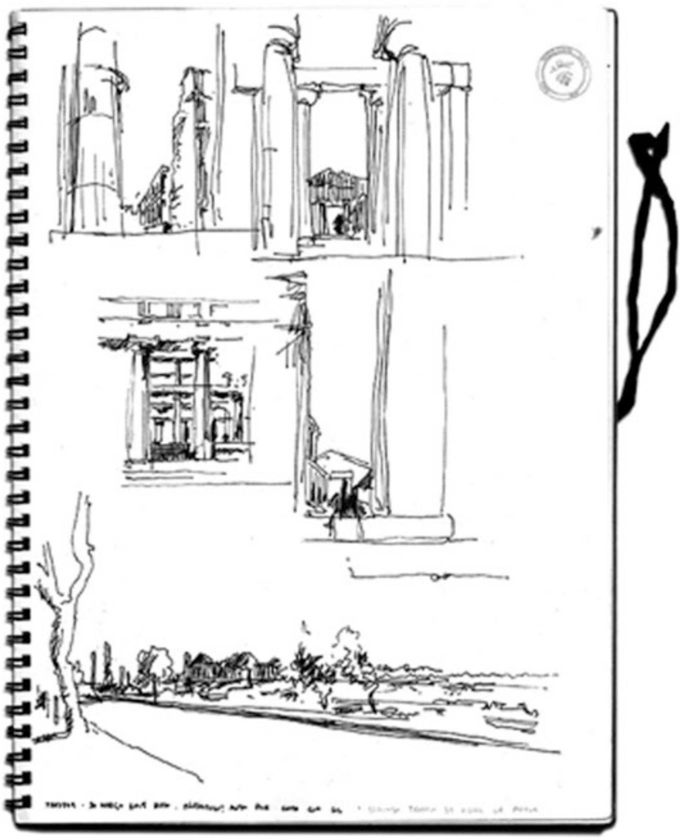

Fig. 4 Hugo Barros Costa. Graphite. Therme Vals. Graubunden. Switzerland

materials, media and techniques, depending on which can be more abstract (suggestions of forms) or concrete. Thus, the bodies or body parts can be represented by lines, shadows, spots, color or any combination of these (Figs 6 and 7).

Some external comments to the blog confirm that this intention is sometimes achieved.

A *zoom* in certain drawings of the blog frames the fast and Abstract lines that maybe contributed to escape from the excessive and static information, when the goal is suggestion (Fig. 8).

8 Drawings of Events

The drawings of events, including concerts figurations, dinners, conferences and of course, like all the other above mentioned categories, can sometimes be included in any of the other mentioned groups.

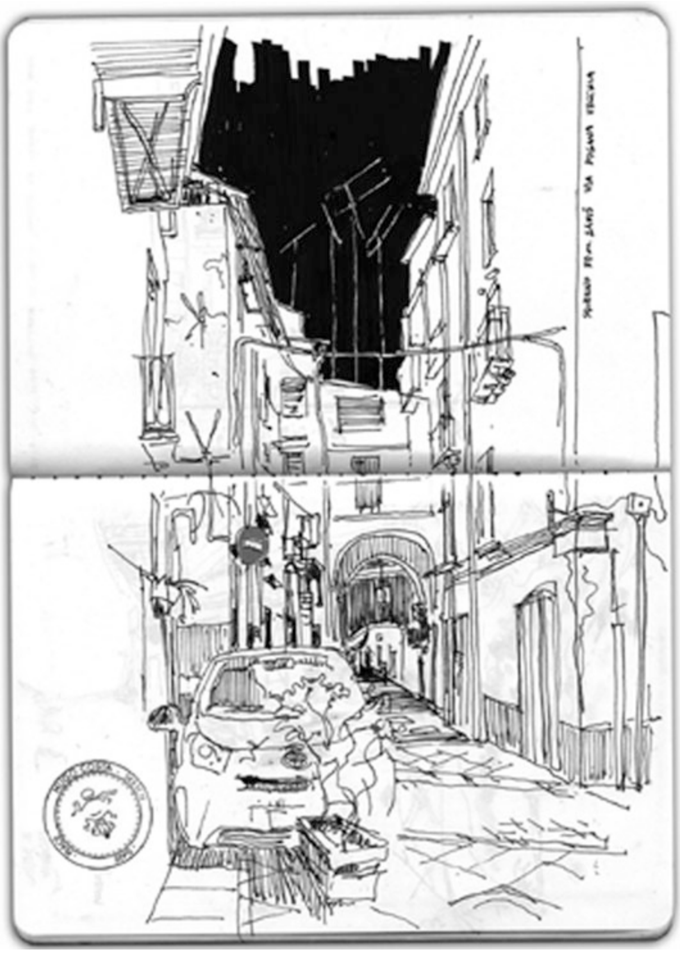

Fig. 5 Hugo Barros Costa. Fountain pen. Salerno. Italy. 2015

9 Drawings of Urban Atmosphere

These are the most difficult drawings to specify. The main conclusions that result from the analysis to the compositions published in the Blog, can be specified in an increasing attention to the detail, to the composition and smaller presence of "isolated object" in favor of more generalist compositions, where a set of elements in various scales define a spatial set or certain experience.

Using the concepts of Norberg-Schulz, the "level of objects" has been unconsciously extended from a more superficial perception of the phenomena to a more detailed one, in this way, the "new" experience to a higher level, of the properties of

Fig. 6 Hugo Barros Costa. Brush and pen. Ballet class. Valencia. Spain. 2015

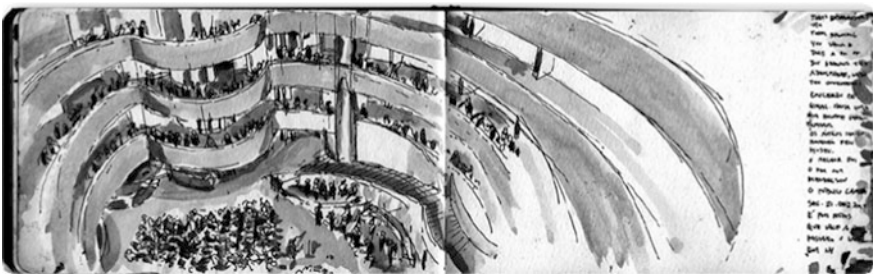

Fig. 7 Hugo Barros Costa. Brush and pen. Concert at the Guggenheim. New York. USA. 2015

these phenomena is reflected in these compositions I call *Drawings of experience or urban atmosphere,* or also *visual epistemology of the contemporary environment.*

According to Frank Ching, "regular and continuous practice is necessary to learn to draw, which is actually about learning to see. (…) To draw encourages us to take the time to pay attention to things and relationships that often go unnoticed." (Barros Hidalgo 2015)

However, I have always tried (I wonder if I reached that goal) *not to* "display" all the intelligible elements in my scenario. I do prefer to transmit "a suggestion", like I fell on Wong Kar Wai movies atmospheric *Frames* to the indiscriminate and non-selective representation.

Fig. 8 Hugo Barros Costa. Brush and Pen. 5th Avenue. New York. USA. 2015

10 The Main Materials

I do not intend in this article to make a compendium (more) of drawing and painting materials, but to expose my personal experience with some of them, and how some of their characteristics, reaction to the paper and climatic conditions, escort and sustain this research on drawing and communication.

In addition, this is often a central issue in blog comments.

The graphite pencil (from B to 8b) has been one of the favorite materials for published drawings, the toughest for detailed representations, and the softer for rapid and *organic* drawings.

Although I normally use softer pencils, lately I have been using a 1B. I combine it with watercolor with high absorptive capacity and heavy weight paper (fine grain).

To combine pencil and watercolor, by own experience, seems far more complex than to use ink (pen, roller-ball …) and watercolor. When the outline that defines the forms of the drawing is performed with pencil, not only the colors but also the forms are left open, sub-sequently being concretized (shapes and colors) with watercolor brush strokes. In contrast, when these lines are made with ink, forms result me, in general, more defined, as if the following watercolor only brought color and light values.

In addition, the ink tends to work in a drawing as the internal structure of a stained glass window, highlighting their colors. On the other hand, to obtain the same color intensity, I fell I should apply more pigment when the geometric base composition is made with graphite.

Brushes like *Pentel* type, calligraphic pens and very thick fountain pens allow me to define spots and shadows as well as to color and specify certain light values. They invite to fast execution drawings and high abstraction level, where for example, the shape of an object is defined through its shadow or the negative space that surrounds it (Figs. 9 and 10).

These exercises of abstraction oblige us to an effort of reflection and assimilation of forms, escaping from our spontaneous perceptions.

Comparing to graphite, pens and ballpoint pens allow better results when scanned, which makes them a better choice if sharing in internet is a goal. Lightweight, reliable and economical waterproof rollerball pens of, featuring several colors and thicknesses, are my first choice. However my pleasure and speed increases when drawing with specific fountain pens.

11 The Color

Concerning to the use of color, Frank Ching, in the magazine EGA Número 25, mentioned that:

"While I realize that many urban sketchers use watercolors, I value the simplicity and portability of a Lamy fountain pen and a sketchbook, especially when traveling.

In addition to enjoying the fluid and tactile quality of drawing ink lines on paper, I believe that the use of lines to capture a scene requires a level of analysis and abstraction that can be beneficial. The idea is not to reproduce a scene but rather to render it visible. This is the magic of hand drawing—its ability to suggest rather than merely describe.

When I do want to record a particular quality of light, color, and texture in a scene, I will do so on my iPhone or digital camera" (costa and Hidalgo 2015).

Unconsciously, the older posts of this blog, were matching Ching's opinion, although timidly, the color in a small part of those. I felt (almost) no need, but rather controlling space through the line and perspective. However, my three months stay in Rome as a visiting professor at La Sapienza, made me completely change that perspective.

To the quote "in Rome, be a Roman" I would add "in Rome, be a Roman and use color". The vibrant pigments that invade the city under such special and distinctive light invite to coloring. Besides the sketchers I met at that city. I may risk saying that with the help Roman painters and illustrators, I learned to use, or better, to understand, how to use color.

Fig. 9 Hugo Barros Costa. Drawing the negative space. Plaza de San Luis Bertran. Valencia

Fig. 10 Hugo Barros Costa. Definition of the forms of a building through its projected shadows. Defining the shape of a building through its shadows. Clinico. Valencia

Trying to interpret the color and light values, forms and scenes are seen with different (I do not risk to say better) character. Thus, our perception of the environment changes. Let's say that this perception goes up in a certain scale, which had already been increased through the line (no color) drawings. We can perhaps identify here Norbert-Schultz's theory of "levels of objects." (Norbert-Schultz 1979)

While drawing and painting, that is no more than having a different attitude towards the reality, we necessarily look at certain aspects we had never understood before, enriching our perception of visual memory.

12 Conclusions

Although this experience in Blog format had the goal to serve a very small group (students of one group of the subject Analysis of Architectural Forms) it has come to reach a much wider audience. The (desired) response from these students was disappointing, the blog has come to reach a much wider audience (150,000 visits from over 140 countries) with respective *feedback* (some curiously, students of graphic areas, but strangers to the UPV).

However, internally, in our School of Architecture, we have managed some small indirect achievements with this website, such as the spread of the pleasure of drawing to certain students and even teachers.

Although, as I said earlier, the dialog directly through the blog did not occurred as I was expecting, these comments and constructive discussions have occurred in the corridors and classrooms of the school.

Some of the drawings submitted virtually in the web, were also physically exhibited at the School of Constructed Environments Exhibition Gallery—Parsons School Of Design, NYC (USA), Colegio de Arquitectos de Valencia (Spain), Centro Culturale Candini Mestre—Venice (Italy) and ETSA Valencia (Spain). At the ETSAV, trying to keep the original spirit of the blog, the exhibition was shared by other teachers and students works.

Other indirect results, since unpremeditated, of this blog, led to the proposal for courses related to issues addressed in it, in the Territorial College of Architects of Valencia, in the CFP (Training Centre of the Polytechnic University Valencia), as well as in other schools and even private entities. The relationship between the page *a fresh drawing everyday* and these activities results in various ways; firstly through social networks diffusion and search engines, which led to invitations to referred activities, secondly, the drawings of the blog constitute raw material and experimental source for the courses that also feed more drawing production to the blog.

We learn to draw by practice and experience and the personal practice is the best way to anticipate questions and understand the possible difficulties of our students.

Since that first invitation to my students to draw every day, I am still struggling to sketch each day. Even originally starting with monochromatic line drawings, with pen or pencil, the use of brushes, color, washes or other graphic values began gaining prominence in this personal and illustrated diary.

We learn new ways of seeing (shapes, colors or absence of them) and how to transmit emotions; I have enriched my personal and academic relationships: the world is now different, more beautiful. In the end, according to Niemeyer's words, is the pursuit of beauty that moves the architect (Barros and Navarro 2012).

When analyzing the drawings published in the last five years, it is clear that the current ones are more generalist in their content, but also more concrete and precise in the definition of shapes, colors and light values. Furthermore, they have been adapting to social networks and diffusion in the internet, in its framing, materials and physical positioning of the theme (light/photography).

On a personal level, the *blog* has become a daily chart where I often return, like to consult an illustrated agenda that renders my past. It is also a vehicle of compilation and dissemination of the graphic work of students and teachers, with a gradual impact over the years, resulting in a mirror of personal development and collaborative research on Drawing, currently being complemented by a parallel investigation with the use of digital technologies and representation, supported by other teachers in the UPV.

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Installations, Stains, Drawings, Structures, Patterns, Maps and Nature (Methodology, Innovation and Self-criticism)

Ángela Ruiz Plaza and Luis García Gil

Abstract The complex shapes that nature offers us is the starting point for an open methodology that proposes new teaching strategies in the field of architectural creation. Through drawing, and by manipulation of elements and materials, they create dynamic learning is based on freedom, where the student is the protagonist of his training. Teaching strategies that relies on complex statements, clear benchmarks and disassembly processes, research and reconstruction processes to boost production open, closed without result where the decision-making capacity, to investigate valued, criteria and initiatives present in the learning process.

Keywords Installation · Structures · Art · Freedom · Drawing · Nature · Complex-shapes

1 Starting Point

When receiving the new students on the first day, the first year of architecture, we have a variety of levels in relation to the graphic skills and a general lack of knowledge about the graphic language applied to analytical and creative developments. The challenge: to apply the graphic language to complex areas such as the analysis and study of space, architecture and urbanism in a limited time.

This starting point, which initially could be inconvenient, is read as a field of opportunity, from the conviction that the graphic language can be learned, it develops from the head and not from the hand, and is essential to disassemble, analyze, build spaces and architectures. In fact, at times, with some "advanced students we must lead them to an exercise of unlearning process, to allow them start a new innovative process of creating.

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2 Contract

Students receive is a teaching commitment, but the commitment must be bidirectional. The formalization of objectives and statements requires the involvement, attendance and student work from proactive in their training. Neither is evaluated nor required to have prerequisite skills. Every student is able to pass from the moment you enter the classroom, if he/she meets the requirements of the contract and uses it to fight and win him or herself.

We propose that each student has a personal sound, which must be discovered. Facing the same assignment, each student will give a different, personal response when done from a situation of freedom, motivation, excitement and emotion.

The student is free to experiment with the means and instruments that will be used to speak graphically with their own language and gesture, but within some clear guidelines to follow each exercise learning process.

In any case, the starting point is a process of "search and retrieval of fire", personal and experimental.

Within a maximum of 84 teaching hours in a semester, we have to achieve the proposed objectives, concepts and mastery of graphic language and development of criteria for working with spatial and graphic thinking applied to the creation of architecture. And this is not possible without getting involved and a proactive attitude by both parties: students and teachers.

The development and work, hands and minds:

> In the land before us, there is only knowledge in the form of lightning. The text is the long thunder that rumbles afterwards. (Benjamin 1982)

Our first goal is to break the ice freezing the initial fears facing the necessity of creation. The only way is to work in a situation of freedom with the students, to be ready and alert to perceive the lighting that will open the road to the ability of creation, personal and architectural. Thus, the course always starts from a collective action, in outer space, an intervention in space, a game, and drawing. The first reference: Jackson Pollock, leads us to learn that not only is drawn by hand, but the whole body is involved into the process (Fig. 1).

3 Gymnasium, Warming Up

This same idea of losing the fear, to flow with the creation, graphic language and expression are repeated daily in what we call gymnasium: 30 min initial intensive heating that allow focus and start the dynamics. They are quick, gestural, non-figurative and relate more to the internalization of the creative process exercises. This is to recover the intervention of the senses in the act of drawing, to experimentally develop another way of seeing and knowing the relationship between body and space, drawing the paths of our body in motion or following guidelines that will reverse the academic dynamic of representative drawing process (Fig. 2).

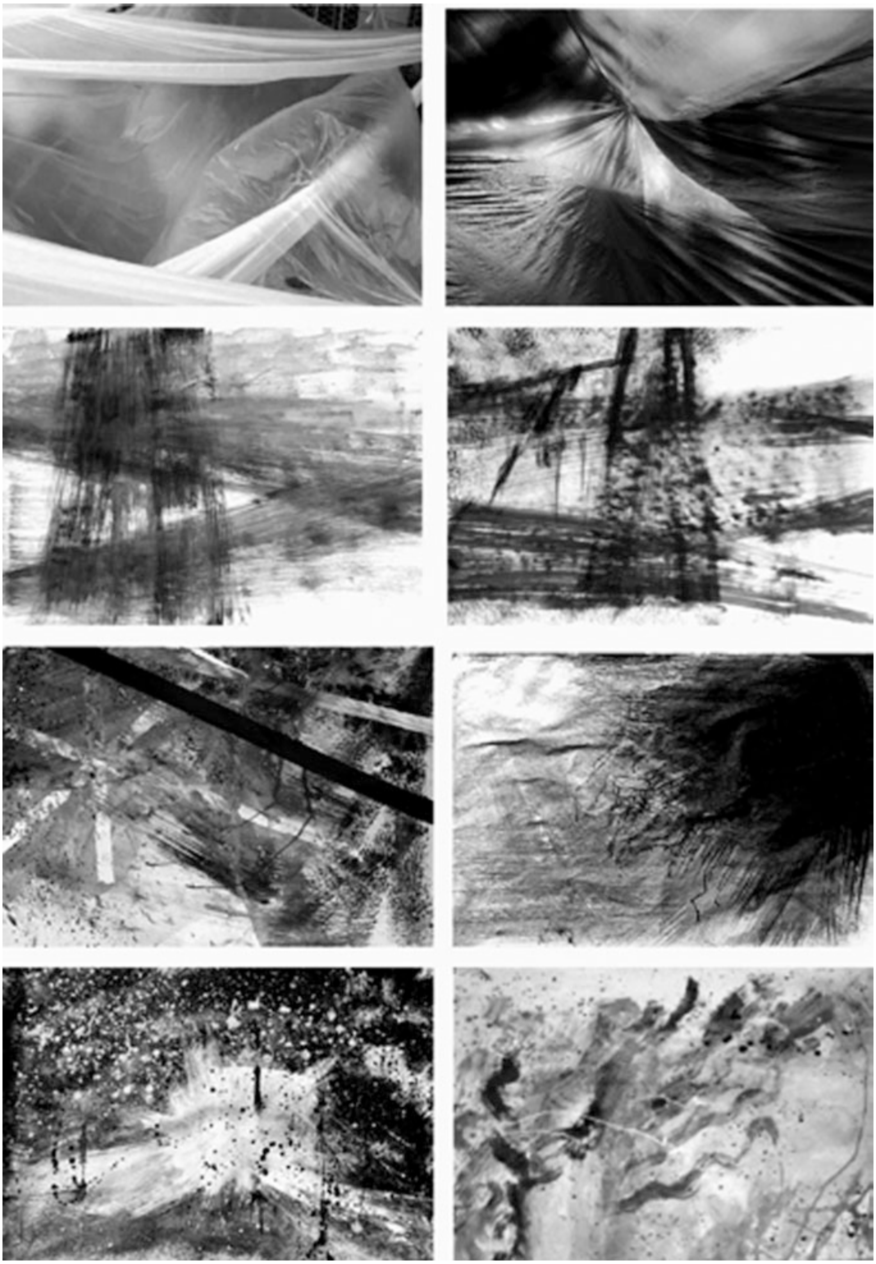

Fig. 1 Installation and initial drawings DAI 1_2013–14

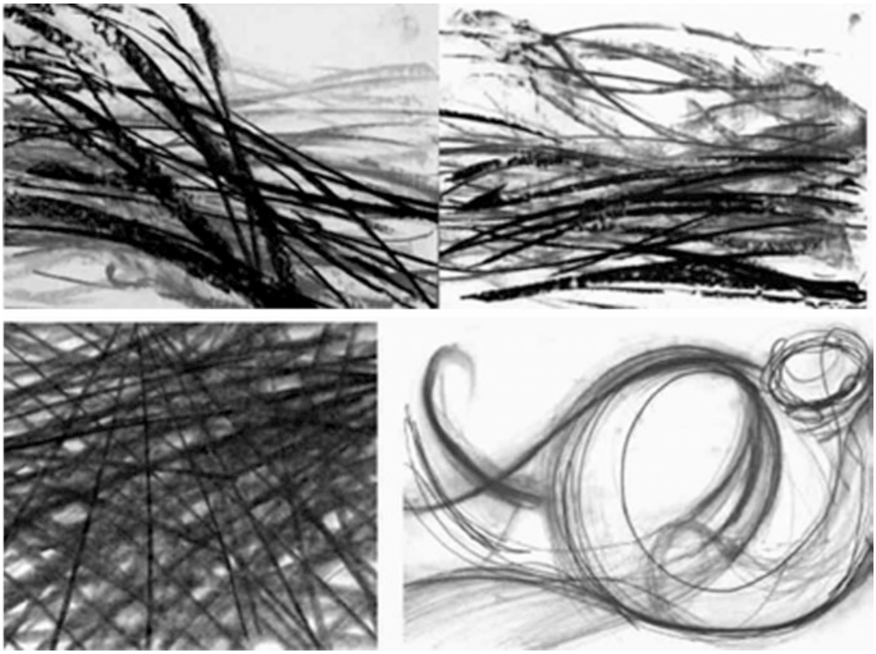

Fig. 2 Gymnasium drawings DAI group DAI 1_2013–14

When starting the process of approaching those strategies to the body, they can change. The body is our natural measure in with which we relate to the environment: we can touch, hear, smell, taste with sight, hearing his hands, touching the ears. Thus, we propose to get to know the space through the senses, and transcribe what sense the paper by means of an envelope or mental images graphics, without visual cues.

The aim is that the student set free his or her autoimposed obligation to represent the reality. The process will lead to a relatively autonomous and unconscious thinking process, while working in writing, crafts, art or architecture (Pallasmaa 2011). An example of this exercise could be the haptics, own and other portraits.

> After the self-portraits I did, blindly, I felt free to let go everything that I had in my mind as prior knowledge and I was able to be guided by the space that was there, in front of me, showing me the path. Alba Rey, 1st year student.

In this first phase of the course, we also works with the human body as recipient device so that walking becomes a tool to explore space.

> … The only architecture capable of modifying the atmosphere was the act of walking, an act that was both perceptive and creative in time and which, today, is a way of reading and writing the territory. (Muñoz 1996)

4 Works and Blocks

Block 00. Drawing as a critical practice. "Intervening in space"

The initial block begins breaking the ice with an intervention in space with everyday objects. Through teamwork, collaborative, proto-spaces which must then be captured in paper space using liquid instruments and very thick (to avoid falling into the detailed), object-representation techniques are created (Fig. 3).

Block 01. Drawing as a process. "Invasions of the classroom. Light machines"

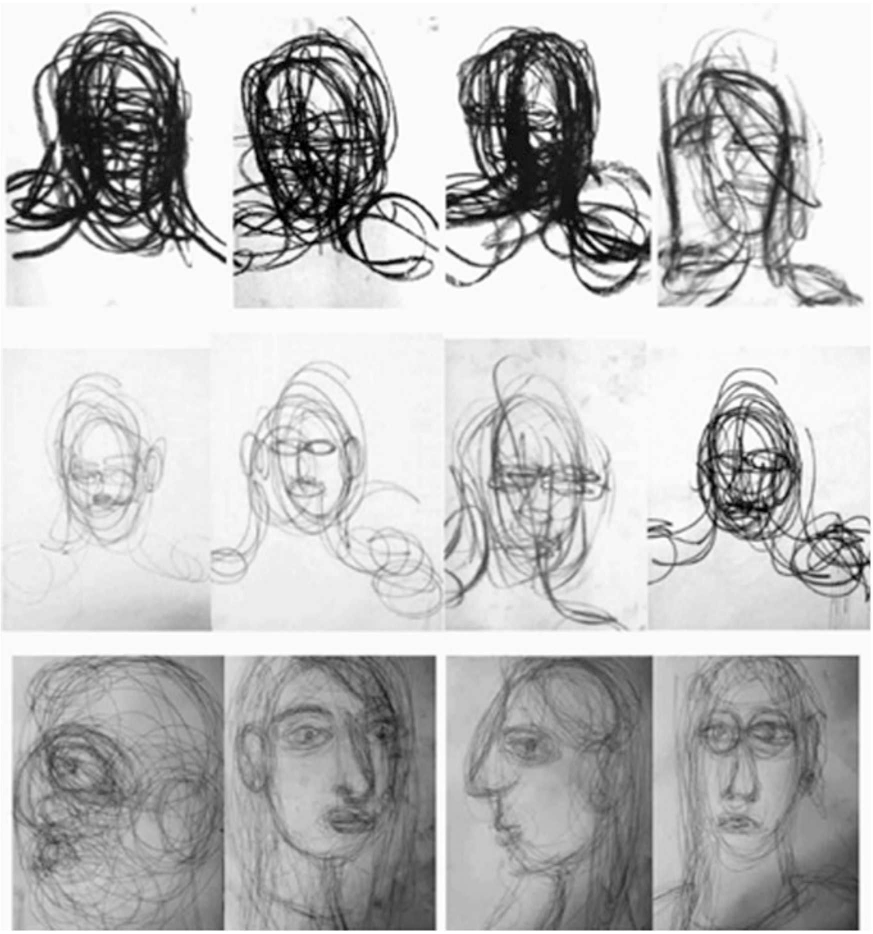

Fig. 3 Haptics group portraits DAI 1_2013–14

The next block is formed as a continuation of the initial, working this time in the classroom, where new collective proposals using existing everyday objects are used to fill the space and create models that will be lit this time artificially introducing light strategically and understanding the importance of light in the changing space. These models will serve as a basis to develop the individual drawings that will be done by catching in paper the spatial proposals. We work now through gestures occupying the whole paper with movement and gestures, working with the object and its shadow, overlapping layers, visible and invisible structures, latent intrinsic order and spatial relationships (Figs. 4 and 5).

Fig. 4 Drawings block 01 DAI group 1_2013–14

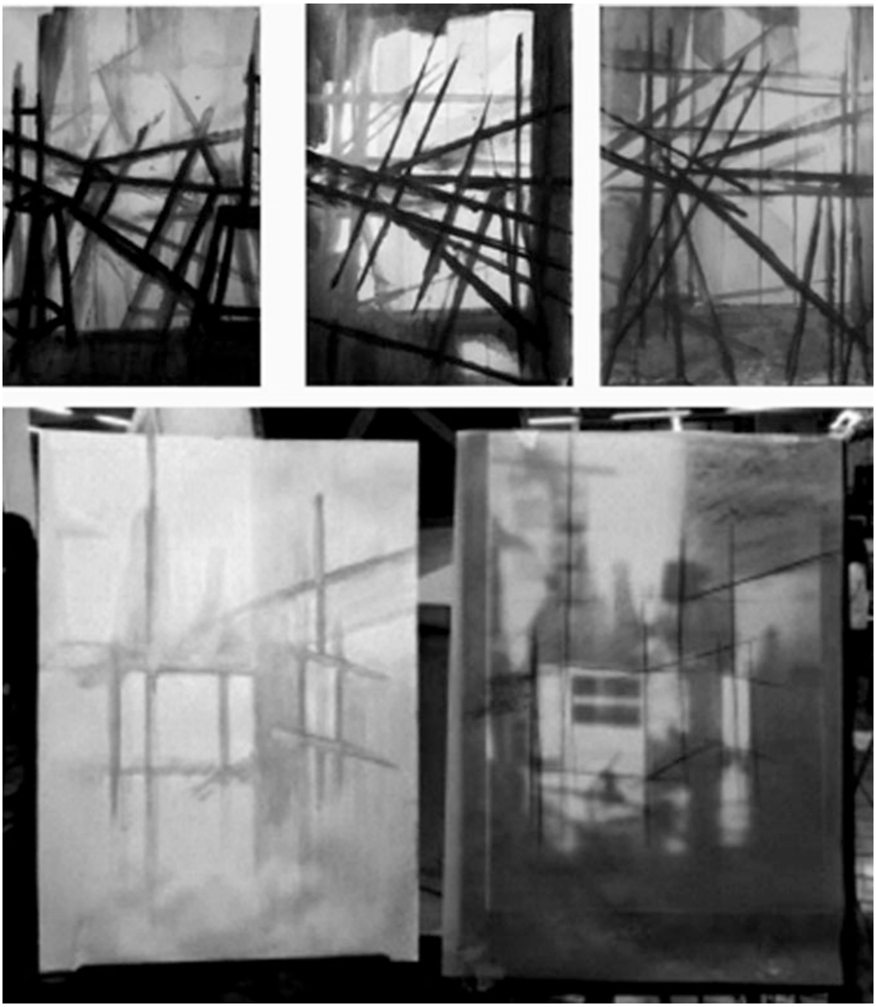

Fig. 5 Drawings block 02 DAI group 1_2013–14

*Block 02. Drawing "*in situ*" as a territory exploration. Intensification workshop: "hybrid landscapes"*

The next block revolves around a "spot" of the territory, outside the classroom exploration. It is a workshop intensification that takes place in Cuenca, where there is a complex reality relationship between landscape and architecture where the student is facing a challenge: apply what was learnt in the classroom, the search for object-structures, and a complex structure of territorial scale, now "in situ" (Figs. 6 and 7).

Fig. 6 Collective drawing representing nature-architecture dialogue in Cuenca. By students DAI 1_2013–14 group

The challenge of tackling the complex shapes, provided that it arises from freedom and leaving aside the fears, it produces excellent results. However, the goal is not getting results but the search process, to transcend boundaries, going beyond what was signed by contract, pushing students to go beyond their capabilities or the idea that he himself possesses great graphic abilities, and is able to get abstracted and surprise him or herself. Therefore, the trip to Cuenca takes place in two phases: The first day the results are catastrophic, students become completely frustrated. After this first day we must work in classroom, with photographies, printed in large format.

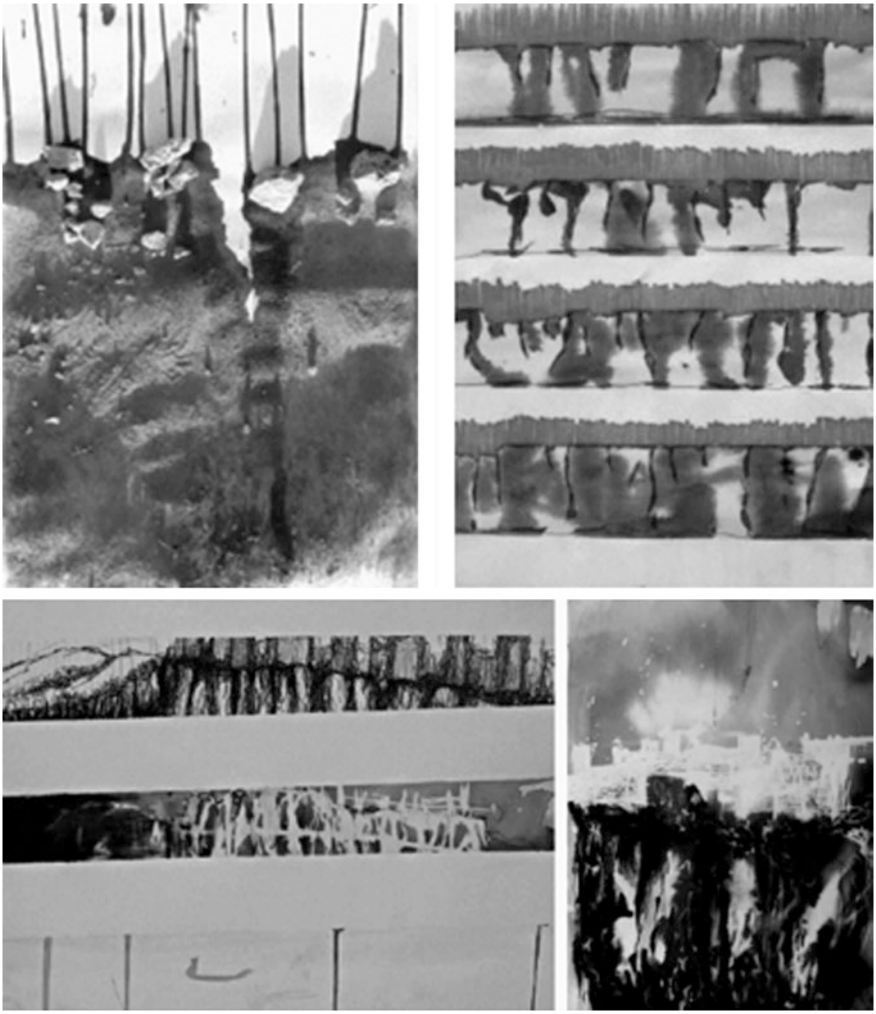

Fig. 7 In-situ drawings. Cuenca. Students DAI 2013–14 group

Then, a structural analysis allows them to analyze the complex relationship of the territory-architecture symbiosis. During the second trip, then, they can start opening the way for experimentation. For that reason we introduce new experimental graphic techniques.

> The trip to Cuenca was a new moment of struggle, because I could not express what my eyes were seeing. I tried to apply what he had learned, but I could not. The vastness of the place crushed my creativity. When working on photographs and further analyze the landscape (through meshes, axes, masses, lights, shadows) I managed to abstract and represent the essence of the place, and finally, produce exciting results very rewarding. Alba Rey, 1st year student.

We can show an example exercise of this new intensified moment that took place in the classroom after the visit, and permitted to ease the way to abstraction, understanding the context and the work of layers. This example is the collective large format drawing done with brooms in a limited time. Working under pressure, densifying the time, and acting collectively the student learns how to let go of mental representation structures previously acquired and create.

Block 03. Drawing as a project. "Post-production/workshops abstraction/ workshop space research"

The last part of the first semester of DAI (Drawing, Analysis and Ideation subject) we were working from the context analyzed and drawn to create hybrid landscapes. They are just graphics experiments based on the work done until that moment, what was drawn and photographed in Cuenca, for, through collage and drawing, create new landscapes (Fig. 8).

At this point a number of benchmarks are introduced, to learn from their creative process, and through it, allow experimental ways of creation. Artist and architects such as: Lebbeus Woods, Mackintosh, Palazuelo, Gego, Viera da Silva and Morphosis.

Block 04. Self-evaluation. "Processes of self-criticism and selective exposition of production material"

The process of creation, production and generation of graphic material should be supplemented by an exercise of collection and selection of the material generated by reviewing the processes that have occurred in the development of learning exercise, drawing and disagreements, successes and missteps, focusing evaluation as a process of self-criticism (Figs. 9 and 10).

The aim is to understand that when developing learning graphic language to produce architectural creation, the result is secondary to the process.

This is the work of a semester in DAI 1, (drawing-analysis-ideation subject), first year in architecture, that essentially creates criteria for own graphic evolution. Those skills will be developed and matured in DAI 2 where we focus on drawing and analyzing complex forms of nature: skulls of animals, trees, rocks, insects or crustaceans.

The observation of complex structures of the natural world allows appropriate formal structures difficult to handle geometrically. To draw them and play with different materials will lead to the creative process based on the formation of the craftsman, where the thinking hand that has experienced certain movements, starts playing structures acquired in this training is activated.

We move from the initial drawings to models, from models to sections, from sections to the architectural space creation using collage.

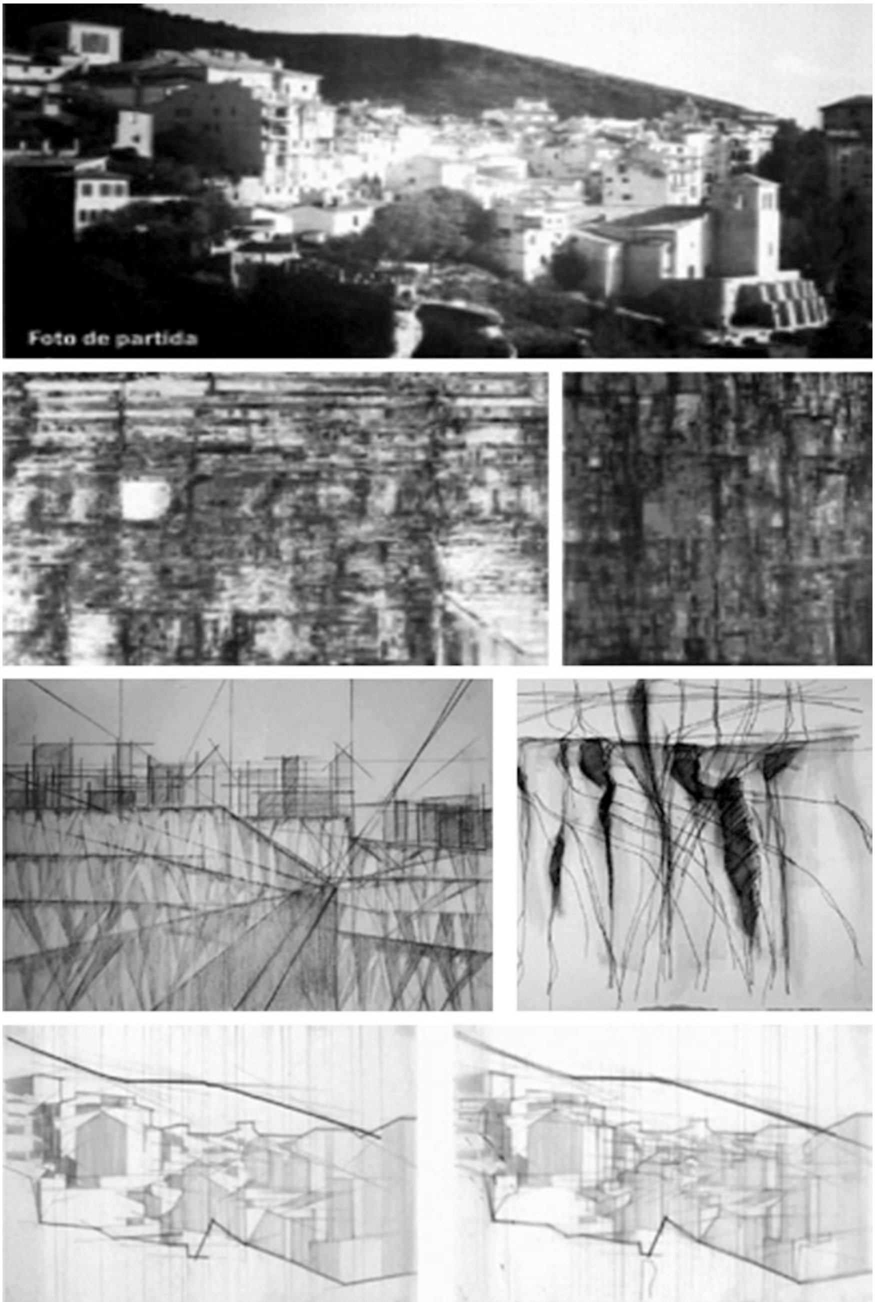

Fig. 8 Drawings in the classroom (block 02) showing the complex binomial nature-architecture

Fig. 9 Benchmarks used for the introduction to Block 03, in order from left to right: Mackintosh, Lebbeus Woods, Morphosis, Palazuelo and Gego. Drawings of the intrinsic structure of Cuenca by the students

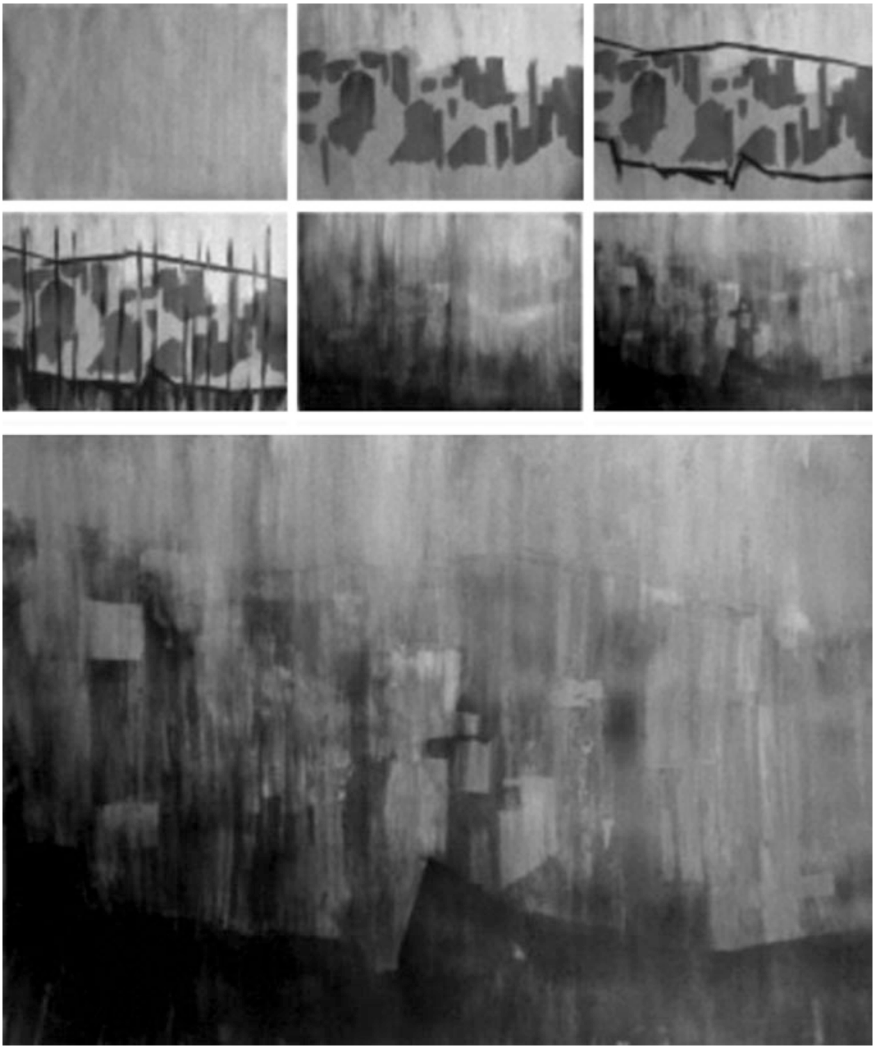

Fig. 10 Latest drawings of the course, a way to last abstraction of Cuenca

5 Conclusions

Drawing is a tool for innovation and creation that allows learning from mistakes, experimentation and freedom, that only comes after the abandonment of fear, going beyond the limits, and allows to develop individual searching processes.

The results are always unpredictable, unique and unrepeatable. The drawing must be open, allowing infinite number of possible resolutions of the system.

"Drawing is always complete but never finish" Leonardo da Vinci

The teaching strategy developed starts empowering students to create their own development strategy, and is based on analysis of existing complex shapes in nature that could let the student to acquire some movements and gestures to play, and then produce spatial creation, understanding also latent structures to meet new configurations based on natural systems.

In our time, the drawing of observation should not focus on the result but on the processes that allow developing the ability to create. This capability is only possible if the fears are transcended and learned to look inward self-criticism, checking, repeating, transforming, solving and re-solving complex graphic equations, and, above all, becoming passionate about creating systems and (architectural) structures that will be configured in infinite results.

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New Interactions Between Fundamentals of Descriptive Geometry and 3D Modeling for Design

Marco Vitali

Abstract The practice of drawing always involves a process of interpretation and analysis, knowledge and synthesis, structured in relation to educational aims and methods involved. In this paper we intend to make some disciplinary remarks on the teaching of "Fundamentals and applications of Descriptive Geometry" for the "Laboratory of Representation of the Project" held at the Degree in Design and visual communication (first year) of the Politecnico di Torino. We feel more and more, both in teaching and in student feedback, the need to rethink contents and to reconfigure practices for the definition of new interactions between Geometry and digital modeling.

Keywords Representation · Geometry · Didactic

> It is too often forgotten […] that the purpose of geometry is not only to give visual shape to the project idea, but also, and above all to simulate construction operations and shape modification, in one word, modelling operations.
>
> (Migliari 2012b, 23).

1 Introduction

The practice of Drawing implies, always, a process that examines the reality and interprets it—through subsequent editions and re-editions—by selecting the most significant data to get a synthesis, structured, from time to time, following aggregative logics oriented on the purposes of representation and declined in relation to the specificities of object and of the involved disciplines. It is a historically consolidated approach to knowledge, practiced and known, which compares and updates, in its application, with opportunities and constraints produced from different media and tools, from different techniques and operational

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methods: as naturally it occurs, the language of the Drawing, living subject that constantly produces new expressions, changes its style and still builds habits in response to the most pressing communication needs.

It is therefore clear that teaching should 'keep in mind' this dynamic and flexible aspect of graphic expression in the transmission of theoretical and disciplinary content: it is necessary that the didactics guides, from time to time, activities and practical experiences with the intent to mature in students the skills necessary to direct, with awareness, the choices that make the act of representing an expression of a critical path of knowledge, processing, communication and sharing. With this we want to emphasize the need to understand the Drawing, even in the educational sphere, as activity that is not exclusively expressed on a theoretical and speculative plan—exercise end to itself—but rather as an experience that builds and declines signs configurations to attribute meaning and structure to the communication, taking into account contexts, purposes and professionals involved. Representing, therefore, even as an action that records and welcomes different critical approaches to the 'knowledge of things'—views of the world filtered in relation to the different involved skills, for example by the project activity—and reassembles them into drawings dedicated to the analysis and description of the different facets of a complex reality.

It is precisely this fragmentation and reassembly of looks that characterizes the teaching activities carried out in recent years, within the Laboratories (as required by the training model outlined by Ministerial Decree 270/04), in which basic disciplines and applications—know and know-how—identify ambitious and multidisciplinary training programs.

2 Different Looks on the Project: Investigation, Knowledge and Representation Paths

In this paper are exposed some considerations about the educational contribution of "Fundamentals of descriptive Geometry" for the "Representation of the project Laboratory" (first year) held at the Degree in Design and Visual Communication at the Politecnico di Torino. In this laboratory converge, in addition to the Geometry, the disciplines of "Drawing for Design" and "real and virtual Representation".

The Lab, aimed to the transmission of cultures, representation tools and techniques, integrates the different scientific and methodological approaches in order to direct students to the necessary skills for the critical management of Drawing for design artifacts, orienting choices, codes and scales of representation, in relation to the characteristics of the object, the specific phase of the design process, the communicative purposes: from the communication of the concept to the verification and control of the project, the communication of use features and constructive, or even the promotion of the product.

In order to achieve the training objective the different disciplines contribute to the definition of goals, transversal and integrated, in relation to the improvement of skills in:

- learning the theoretical content at the base of projective methods, for a precise control of the shapes of the project, through descriptive Geometry;
- management of the communication related to characteristics of the object (formal, expressive, functional, etc.) through the manual render;
- description of the project and its detail elements through the normed technical drawing;
- communication of the project through the acquisition of skills and instrumentality needed to build models, real and virtual;

On the basis of these proposals, the teachers group of the Lab has structured a practice, common to the different disciplines, which allows students to try their hand—on the same artifact—on the control of communicative registers, comparing the different graphics outcomes: the practice, conducted over the entire duration of the course, expected that each student choose autonomously a common object, from year to year belonging to similar categories[1] (for which are fixed some essential characteristics, such as the presence of geometric shapes suitable for the analysis, the complete removability in a suitable number of components, the presence of more materials and *textures*, an adequate size for a 1:1 scaling, etc.…) and that he devels, with the support of the teaching team, all the representations necessary to mature, calibrating codes and languages, the skills listed in the goals (Fig. 1).

In relation to the achievement of these objectives the experience gained by the teachers' group, that for some years now participates in the activities of the Lab, it has highlighted the importance and the need to outline paths—refining from year to year, its "track"—to guide students to the identification of more efficient sequence of operations in the communications of Design project: the different languages of the Drawing and the results progressively obtained by using them acquire prerequisites values towards each other, highlighting more or less virtuous routes. Without denying the educational value of the copy, or rather of the copying action, or even the new edition (as a process that gradually corrects errors and improves procedures) in this case are understood as 'virtuous' those experiences which allow to face problems, by subsequent levels of complexity, or even to re-edit drawings in consecutive versions, superimposing layers of information sequentially necessary to each other, etc. One example among many, or one of the possible logic to support the representation process for the project: the structure of geometry in support of the shape of objects, detection and communication of artifact characteristics (physical, technological, of use…) through the manual representation and the standardized Drawing, the construction of models, in this case first virtual and then real (Fig. 2).

[1]Such as, for example, tools, appliances and mechanical kitchen utensils, lamps, etc.

Fig. 1 Some of the objects used by students for Lab practice: squeezer *Beper 90.302/B*; mincer *Regina A.06*; kitchen scale *Decochic*; alarm clock 'light and sound' *Autovox*

Evidently it is not linear paths, nor standardized operating methods, but integrated and particularly complex processes in which, in addition to the need—on the part of the teaching—to forward the basic graphic skills, is added of the difficulty of stimulating learners to the recognition of the content's specificity and languages for the various disciplines.

As to the role played by descriptive geometry within this team, the "challenge" is born from the desire to build, through the analysis and interpretation of complex shapes of Design, tools and languages needed to project definition.

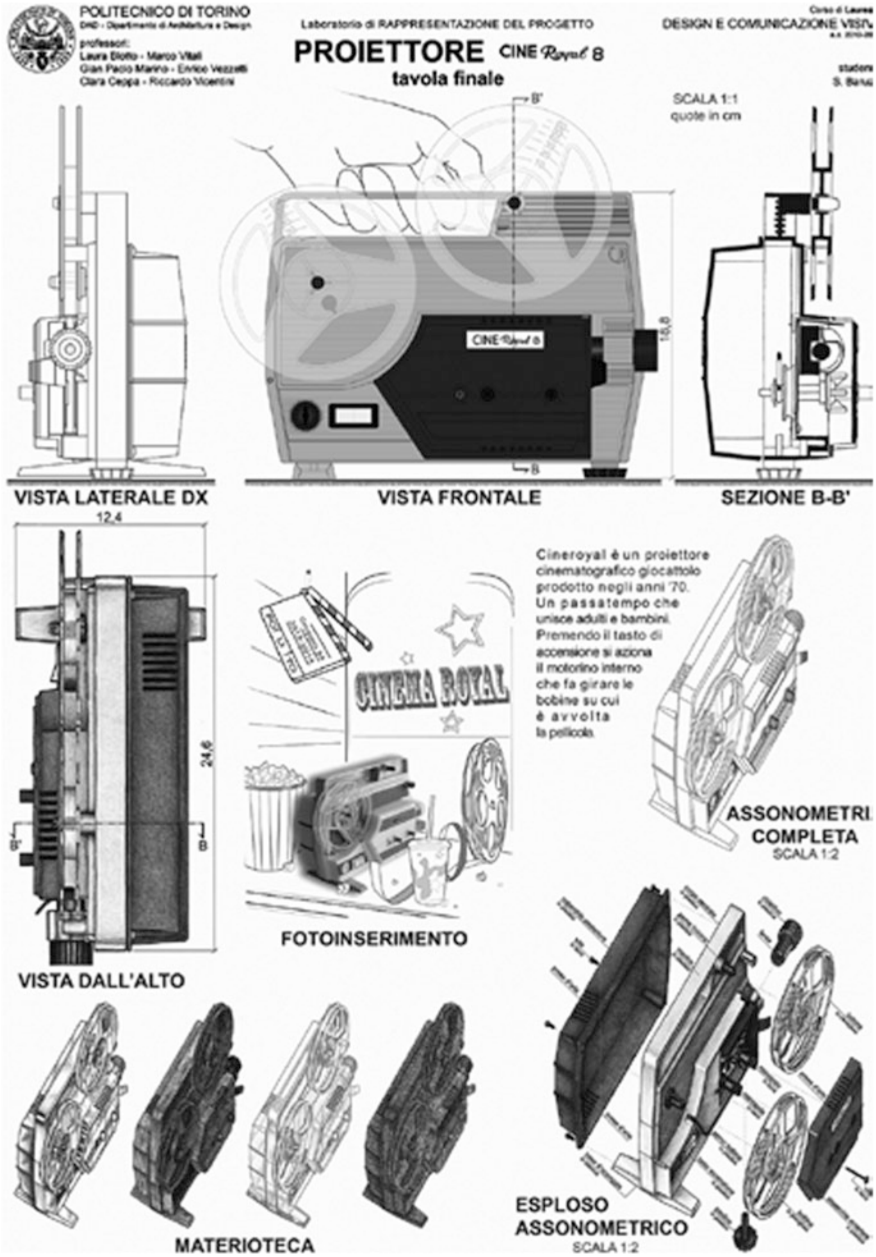

Fig. 2 In relation to the objectives agreed with the teacher team was proposed to the students a summary board that, comparing the qualities of different representations, outlines the process of analysis met. S. Baruzzi, 2013–2014, projector *Cine Royal 8*. G. Filardo, 2013–2014, vegetable chopper

3 The Teaching of Descriptive Geometry in the "Representation of the Project Laboratory"

Reasoning in more specific terms the role played by descriptive Geometry within the training program offered by the laboratory, the crux of the matter seems to be the use made of it for the description of the design shapes, by embedding them within a geometric-spatial grid.

Precisely for this purpose, an introductory work to the synthesis practice is proposed to the students, in which it is required to analyze in graphics terms (with freehand drawing and sketches) the complexity of the assigned object, breaking it down into basic geometric shapes and thinking, where this is possible, for simple operations of addition, subtraction, juxtaposition etc.: This obviously entails a particular effort of abstraction by students who must, from seemingly free forms of the artifact (or its individual components), study and recognize the primitives that describe its superficial trends, comparing every moment with problems of simplification, approximation, matching and/or stack- ability of the geometric model to the real.

Depending on the characteristics of each object, this "reading" operation sometimes results in the recognition of solids or surfaces easily definable from the geometrical point of view (solid primitives, ruled surfaces or portions, regular or double curvature, etc.), sometimes, when such surfaces are more articulated and less recognizable (think for example to "free" surfaces and/or ergonomic), in the description of the shape through the identification and the tracking of a series of significant or detectable sections.

Of course, in parallel to this phase, dedicated to the construction of hypotheses on the geometric definition of the formal characteristics, it develops an interesting activity of survey of the real object, conducted in synergy with other disciplines of the laboratory, where numerous direct and fast inspection techniques of measurements converge (Fig. 3).

Starting from the assumptions, matured and verified by the survey operations, it proceeds to the representation according to classical projective techniques (orthogonal projection and axonometry), which through the descriptive Geometry construction make up the artifact shapes, defining intersection lines and fittings of surfaces (for example, the typical case of the geometric representation of glass and spout of any pitcher) to which are added the 'ideal' lines of transition between surfaces which do not present solutions of continuity. This work constitutes an interesting scope of what is proposed in general terms during the theoretical lessons, constituting an articulated repetition of classic exercises, addressed from time to time through the most popular methods (if this is possible) or through less usual constructions, proposed for individual application cases (Fig. 4).

A further aspect of particular interest, in this exercise, regards the choice of graphical languages used for individual representations, the primary purpose, as said, is to control the geometry of the shape, a particularly important issue in the specific case of artifacts in which is evident the morphological complexity: for this reason we propose to students the representation (both two-dimensional and

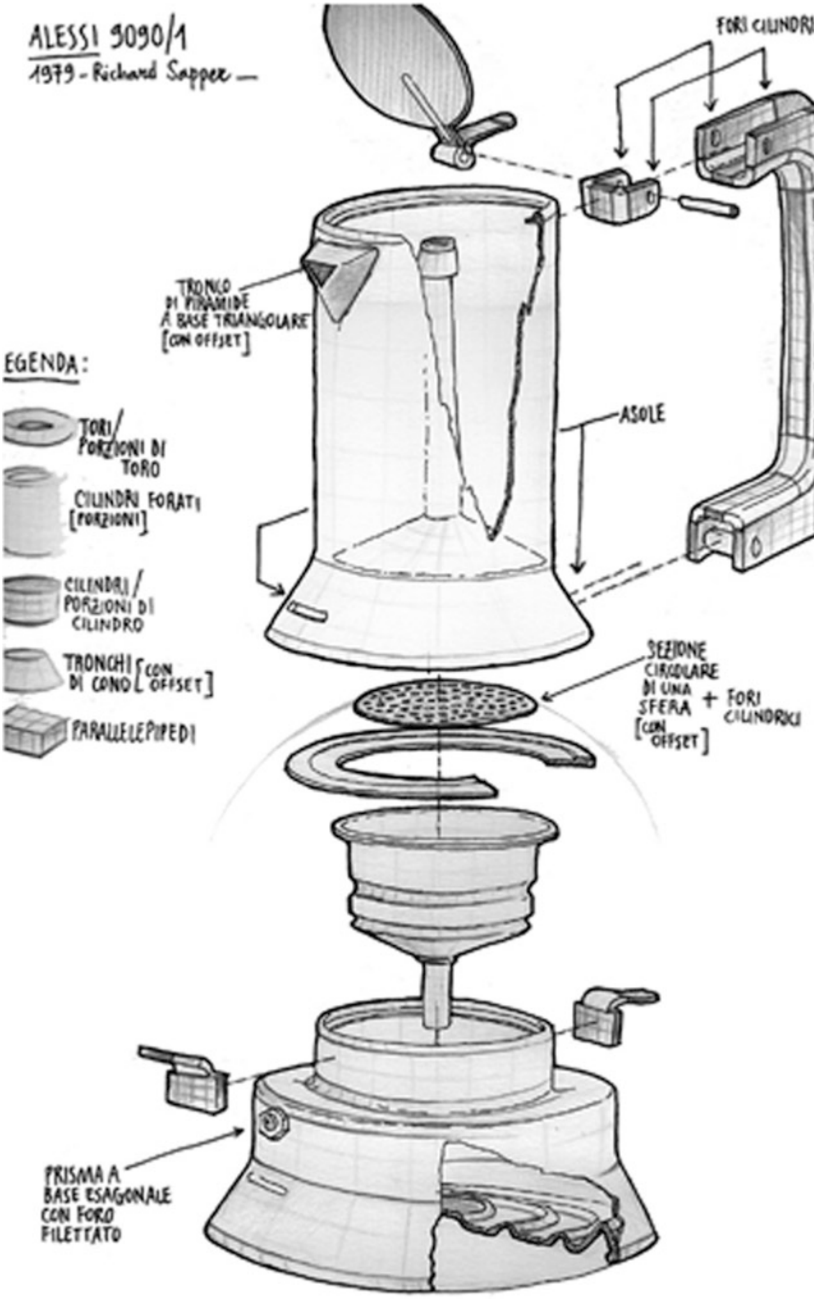

Fig. 3 Practice on decomposition of the shape and identification of geometric primitives. T. Boccheni, 2014–2015, coffeepot *Alessi 9091/1*

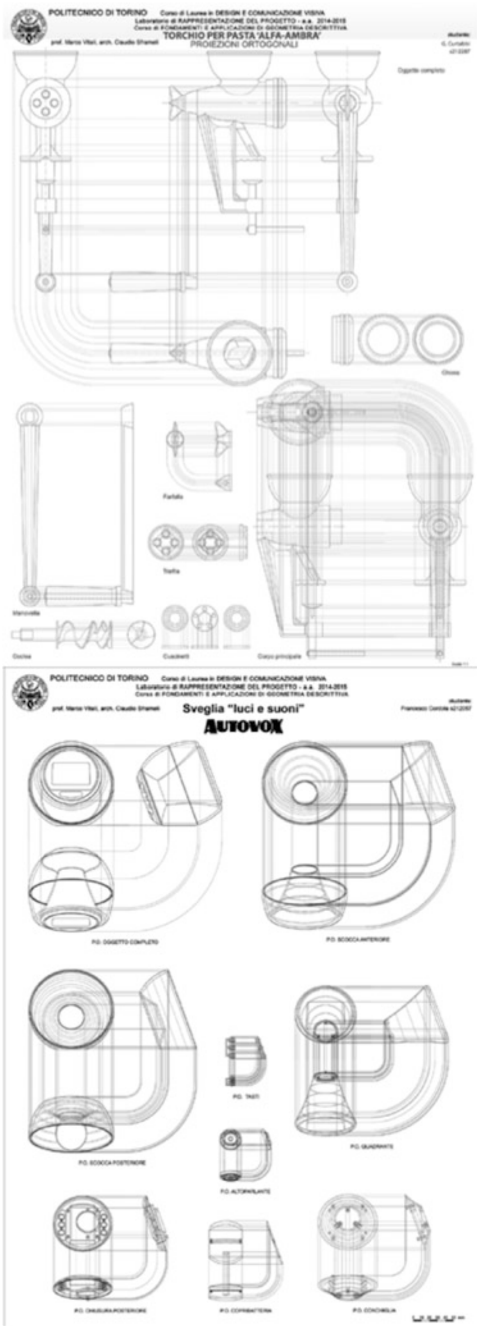

Fig. 4 Geometric representation of the object and its components: orthogonal projections. G. Curtabbi, 2014–2015, press for pasta *'Alfa-ambra'*. F. Cordola, 2014–2015, alarm clock 'light and sound' *Autovox*

three-dimensional) of the individual object components, using the theoretical geometry conventions (representation of hidden lines, of the theoretical axis of rotation and symmetry, etc.) in order to focus the attention and the control on how the shape of each of them should take account of the juxtapositions, the joints, the reciprocal movements of surfaces in the assembly of the parts, very controlled aspect in the exploded axonometry and axonometric sections (Fig. 5).

When defined these congruence aspects of representation in relation to the purposes and specificity of the language of descriptive Geometry, the aspects that bind these graphic products to digital drawing remain to be faced, and more in detail three-dimensional modeling, as well as the effects that the increasingly massive introduction of 'digital' has on the use of descriptive Geometry and its applications for the management and representation of shapes in space.

In relation to the considerations set out above, in the next section we will try to give some answers, even if partial, to the questions that turn around the relationship between descriptive Geometry and digital modeling and that are expressed by the disciplinary debate at a national and international level. Current trends have already been highlighted, in the recent past, by several colleagues but many are still the aspects to think about: what obviously can not be separated from the observation of students in relation to the continuous updating of skills, graphics capabilities and representation tools. In fact, on these dynamics, is evident more and more, both in teaching and in student feedback, the need to rethink the ways to provide the disciplinary contents and reconfigure exercise activities to define new interactions between geometry and digital model: a constructive dialogue through which it is possible to distill the theoretical issues necessary to control the process of analysis and interpretation of shapes, of three-dimensional modeling and technical representation (Fig. 6).

4 The Role of Descriptive Geometry in Relation to the Techniques and Tools Update

Concerning the theme focused on the renewal of descriptive Geometry in relation to the evolution of representation tools, national and international scientific community is now questioned by some years on strategies to ensure new life and new developments to a discipline that seems, by some decades, have arrived at a point such as to require urgently a deep reflection,[2] both as regards research, both as regards the teaching aspects.

In this regard, it seems only right to recall some of the many initiatives that have focused on the problem and that characterized some of the meetings and

[2]In this regard, we indicate one of the last international meetings on the subject: "The 15th Conference on Geometry and Graphics (ICGG 2012)", Montreal, Canada, August 1–5 2012.

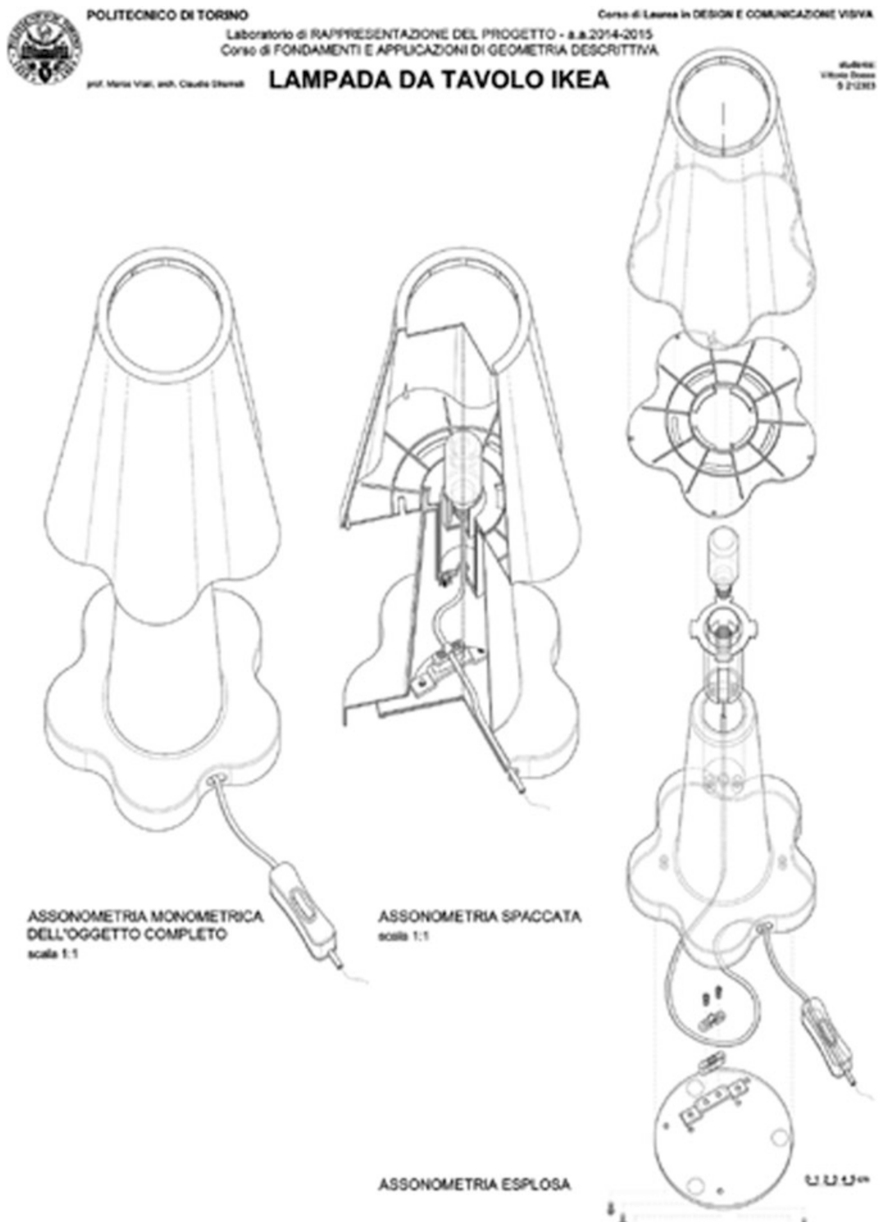

Fig. 5 Axonometric representation for the communication of the geometrical characteristics of the object: exploded axonometry and axonometric sections. V. Bosso, 2014–2015, IKEA table lamp

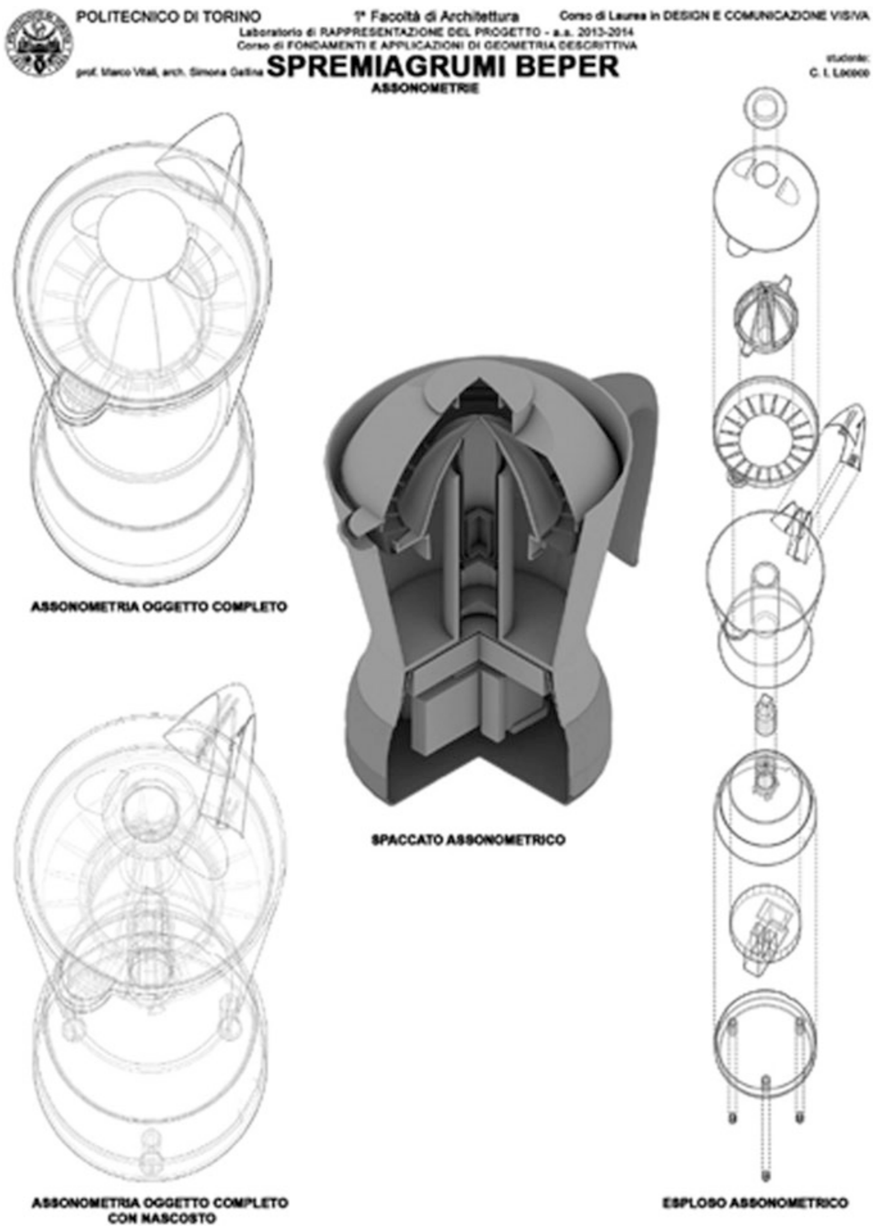

Fig. 6 Three-dimensional modeling and geometric representation. C.I. Lococo, 2013–2014, spremiagrumi *Beper*

conferences of recent years, particularly in the national scene, demonstrating the vitality and commitment that a good number of scholars has shown towards this subject[3]: the numerous conferences and seminars of the Rome office (2003, 2007, 2009–10, 2012),[4] the birth of the website DG_LAB,[5] the conference in Florence on the teaching of descriptive Geometry (2008)[6] —on the occasion of which has been presented the *Manifesto sul rinnovamento della GD* (De Carlo, Migliari 2008)—, didactic manuals of 2009.[7]

Regarding the research, the most common conduct see from a side the position of who, for which the traditional descriptive Geometry can not give any more anything from a scientific point of view, from the other the conviction of who think that can be room for further studies, which (starting from the introduction of computerized procedures for the review of the traditional descriptive Geometry) encode new methods and procedures for the settlement and expansion of known problems. However research aspects is definitely difficult to deal with and is certainly not a goal of this contribution to anticipate possible scenarios, that some accredited scholars have tried to outline, albeit with due caution and difficulties.[8]

About teaching the issue is apparently easier and, as briefly exposed, has been addressed several times at seminars and conferences. One of the main problems discernible in teaching descriptive Geometry is surely to be associated with a serious depletion of the Drawing disciplines, which was the result of a number of curricula reforms that took place during the last forty years, but this problem is associated with the “time excessively along that our Scientific Area has taken to assimilate digital technologies. I allude to those technologies that, for a long time we have continued to call “new” and that, in reality, were not new but were renewed so rapidly as to make them appear more and such “(Migliari 2012b, 24).

If, as Migliari, we consider the descriptive Geometry as a “gym of spatial conception” or “science that combines abstract thinking with the synthetic testing, implemented through the image, of the insights processed from the thought” (Migliari 2012b, 27), where the act of ‘representing’ means nothing more than

[3]For a more detailed description of many study meetings here briefly mentioned, see the text of Laura De Carlo (2012).

[4]The seminars and conferences on the subject, held at the University of Rome La Sapienza, have formed a reference for scholars interested in the topic: “L’insegnamento della geometria descrittiva nell’era dell’informatica” (23–24 may 2003), “Informatica e Fondamenti scientifici della rappresentazione” (february 2007), “La geometria descrittiva e il suo rinnovamento: Seminario nazionale sul rinnovamento della geometria descrittiva” (dicember 2009—mars 2010), “Elogio della teoria. Identità delle discipline del Disegno e del Rilievo: XXXIV convegno internazionale dei docenti della rappresentazione” (13–15 dicember 2012).

[5]*Dal noto all’ignoto”: laboratorio nazionale per il rinnovamento della geometria descrittiva*. The website, promoted and coordinated by Laura De Carlo and Riccardo Migliari is available at http://elearning.uniroma1.it/course/viewphp?id=857.

[6]“La geometria tra didattica e ricerca”, held in Florence, 17–19 April 2008, University of Florence.

[7]Migliari, Riccardo. 2009. *Geometria descrittiva, metodi ecostruzioni*. CittàStudi. Novara.

[8]This refers to the number of publications and studies Vito Cardone, Riccardo Migliari, Laura De Carlo, for which you can see the references of this contribution.

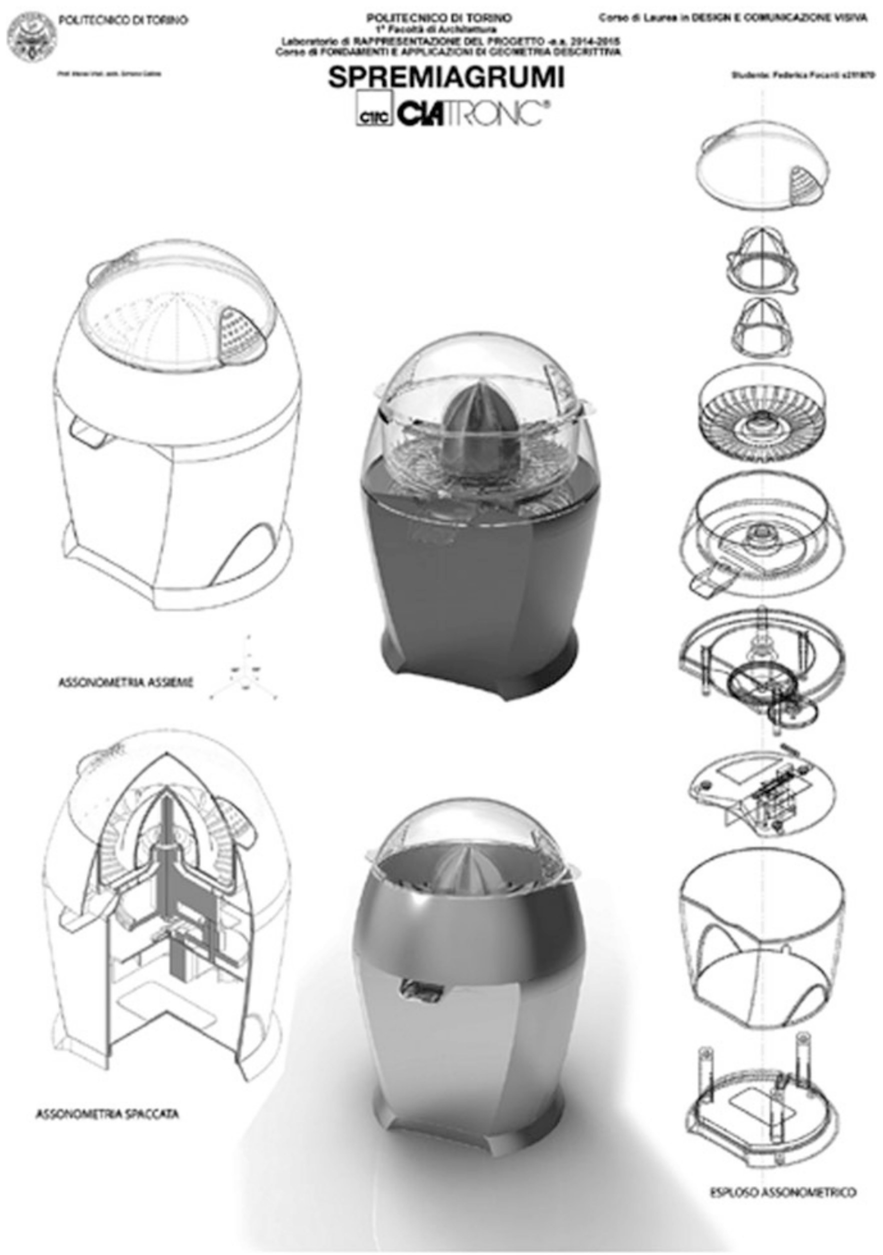

Fig. 7 Three-dimensional modeling for geometric representation and rendering. F. Focanti, 2014–2015, squeezer *Clatronic*

'to build' shapes in space, regardless of the instrument used, we can easily realize how the relationship between geometry and digital modeling can still be a disciplinary enrichment: the representation is not to be understood only as the projective process, but—even before—is to be considered in its value of process which uses the laws of geometry to control and modify shapes in three dimensions. But as instrument is to be understood, reasonably, as a compendium in addition to traditional tools.

"What today no longer makes sense to teach to everyone and is possible and desirable to leave are the laborious procedures to arrive at solutions of complex problems, since these can be found in other ways. Ultimately it is not to not teach more traditional descriptive Geometry, but to teach it in a different way, and, in particular, to teach that geometry necessary for the immediate and complete control of three-dimensional space, functional to the logical computer representation" (Cardone 2012, 21).

It is clear that the teaching of descriptive Geometry should reformulate the theoretical contents in relation to current 'construction tools' (also intellectual), paying particular attention to esercitative mode for the applications, but the challenge is within our reach.

5 Conclusions

Bringing back the discourse on performed activities, from which are here briefly reported the results, it seems strange that the renewal that the scientific debate is dealing with in these years find in students an expansion fruitful field. In fact, although the three-dimensional modeling can find space in the training curricula of our students after the experiences of the "Representation of the project Laboratory", many students, for some years, independently undertake the path of learning and use of IT tools for the construction of digital models. Often they achieve respectable results and perform a self-training—although supported as much as possible by teachers in relation to the general settings of the working group activities—coming to encouraging levels of awareness about problems of geometric construction in space. These are just small openings through which it is possible to glimpse future developments of the teaching of descriptive Geometry, but they encourage wider considerations in the definition of training, prerequisites and sequencing of courses (Fig. 7).

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Practical Actions in the City: Designs for an Environment

Ana Torres Barchino, Juan Serra Lluch, Aitziber Irisarri López and Anna Delcampo Carda

Abstract The aim of the present text is to explain the contents and the teaching of the course entitled “Product and Environment Colour Design”. This course is included in the “Specialization” called “Products for Collective Use” of the curriculum of the Master’s Degree in Design Engineering. It develops several concepts, procedures and, finally, the design of a specific product to be exhibited in urban environments and local stores. The proposed designs by the students of the Master’s degree are based on the study of colour and the interpretation of several featured authors with renewed artistic works and contemporaneous stiles. The present text explains two different ways of developing the final product designs: on one hand, students work throughout the design project learning; on the other hand, students work throughout the study of colours and shapes attending to the most influential contemporary art movements.

Keywords Arte-Diseño · Lugar · Escenografía

1 Introduction

The School of Design Engineering at the Polytechnic University of Valencia offers the Master in Design Engineering within the European Higher Education Area.

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Since its inception in 2007–2008, the faculty of the Department of Architectural Graphic Expression has taken part in this Master, with a curriculum that covers a range of courses focused on the knowledge and habitual development of Industrial Product Design.

Contributing with new concepts, methods of study and development of a project, we aim to generate courses with more appropriate contents for the culture of design in order to foster the involvement with the society.

Given the multidisciplinary faculty involved, the Master focuses not only on the product, but on the techniques used to set it in a space, place or environment, providing new ways to understand design in its various perspectives: starting with the knowledge and analysis of an object, up to the study and creative development for its public use.

It is in the specialization module, entitled: *Products for Collective Use* consisting of various courses where arise more practical and closer to the user contents. The courses deal with different lines of action, which represent different objectives within the creative process of every project, such as: product design for urban environments and events; design for exhibition spaces and temporary facilities design.

We emphasize as well that, in each and every learning content and project developed since the implementation of this Master, the good connections exerted by the faculty with related firms would let join educational and professional work, bringing students closer to the reality of an increasingly versatile industrial design.

It should be noted that the most technological and color-related courses in this module stress on the process, development and finish of the product through proposals, combinations or chromatic organization such as digital displays, using techniques and instruments adapted for each case to find an optimal result for the posed design.

In this regard, solving the aesthetic problems required by the design of a product demands a coherent and consistent creative project, as defined by André Ricard: "The design task in the creation of industrial products lies in setting up a better relationship between the product and its future user, both at the level of the service that the product will provide, and at that of its integration into the cultural whole of which it will be part of. So it can only be an industrial product design to the extent that its use will require direct contact with the user" (Ricard 2000, 171).

Based on this and other reflections on design, the proposals and initiatives of the faculty have been those of managing and performing activities with companies, groups of users, debates with designers and meetings with commercial associations during the design process.

The design proposals for each of the disciplines aim: to pay attention to the requirements, that above all, the society demands; to unify concepts at the beginning of each course; to coordinate needs and types of products agreed with the business companies; to favor research when developing a product that, in our case, is the starting point to boost the students to perform the creative tasks involved in design.

At this point, the addition of different fields in design studies allows for the opening of new creative ways that revolve around movements of disturbing cultural and social versification. The latest trends spread by the media, exhibitions, activities and publications, materialize extensively and globally, announcing changes in the design that most deals with culture and towards an art closer to the recent times avant-garde (Julier 2010).

2 Contents: Design and Develop a Project in a Commercial Space

As indicated in the abstract of this paper, the courses of the Master in Design of our department are included in the specialization module entitled *Products for Collective Use*.

The initiatives and design proposals, developed by the students in their final-year projects, are based on the requests of business companies or public associations to make street furniture elements in order to generate new environments or daily-use products (technological and accessible), ideas ever conceived and designed for the city. These requests are managed by the faculty through competitions and exhibitions, showcasing the designs of useful products ready to be integrated into the public space.

Thus, the two ways indicated in our abstract are focused on promoting a project based on experience and interdisciplinary concepts which tries to bring a real problem into the classroom at the request of a company and use the most appropriate means, techniques and production processes. On the other hand, we transmit to the student the proper bases and concepts to carry out the project exploring the implementation of new issues and contexts, such as art and design culture as main supports for innovation.

This way, in the course called: *Color in Product and Environment Design*, we focus the research on the study and the learning of adapting designs to help liven up commercial spaces and highlight a product exposed for sale among the top issues. As a result, small and medium businesses, specifically dedicated to craftwork, needs solutions that provide their spaces with a creative vision, aiming to please and bring in the public to the purchase of a product delving into the most recurring innovation, proliferating the *branding* methods (Julier 2010).

It is implied that such activity is based on the learning of a specific project, which aim is to work from the generation of the idea up to its full-scale construction. The research of the proposals is based on an initial and illustrative outline given to the student, who must understand the process and generation of a design that should be created for a collective use.

This scheme, designed to raise the student's interest, basically consists of bringing him closer to: the real world; the enterprise; manufacturers of products and services; professionals in the design area; commercialization; the phases of production; the latest trends and, obviously, the society.

Quoting André Ricard again: "The creation of industrial products is subject to creative problems of very different types, corresponding to the various facets and disciplines required by the industrial product. Basically we can differentiate three types of areas: operative = subject to the laws of physics; manipulating = to facilitate the comfort of use, and processing = to enable the production" (Ricard 2000, 165) (Fig. 1).

We emphasize that the intention of the faculty of this course is to get the students to show the most creative aspects of the process and resolution of the project, as well as delve into one of its principles: connect art and design as a unit. Concepts that sum up in the search for information on contemporary art focused on the study of form and color.

The phases of study and research, carried out on color, new trends, production, new technologies and industrial development generated lately, allow for a knowledge of this issue that is very useful in design studios involved in the creative process of the designer.

In short, having an overview of what design is today as a whole, where art greatly influences the creative process of the planner/designer. The theories of Bruno Munari, in the sixties, predisposed in this field towards the connection of design with plastic arts and artistic experimentation, pointing out that the designer signifies the object and its final form has a psychological value at the moment of purchase by the buyer; materials, color, function and aesthetics in a consumer and industrial world (Munari 2005) (Fig. 2).

For it, the study directly observed in a commercial environment, the search for authors and artists or avant-garde schools, and visual perception knowledge, light and color, exert a progressive increase in the creative capacity of the students (Press and Cooper 2009).

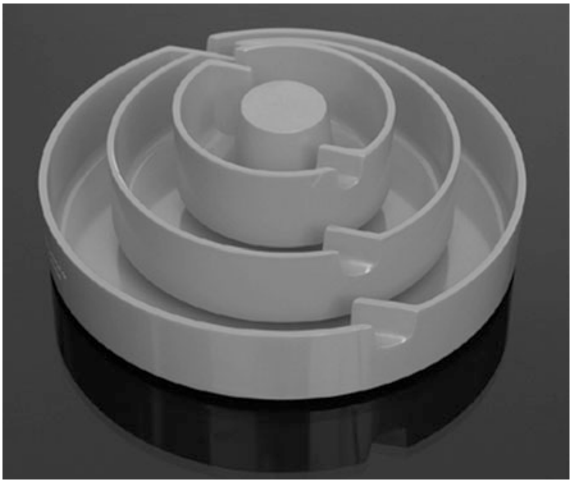

Fig. 1 Cenicero Stockholm. 1967 André Ricard

Fig. 2 Lámpara Falkland. 1964 Bruno Munari

The enthusiasm roused by such research generates a series of formal interpretations that appear through the work of construction and installation of the selected elements in a space.

Again, it is not only the experimentation and interpretation of artistic forms and compositions or visual games that is valued, but the creation of new proposals with new and old materials. Design analyzes the contexts, the experience and the role of designers as the third millennium moves forward; it interconnects two main and fundamental ideas. The first one is that design must be regarded, more and more, as the process that generates meaningful experiences for people […]. The second idea is that being a designer is, radically and irrevocably, volatile; new tasks arise, methods and activities that give a greater importance to the innovative and transcendental research, associated with creative methods, effective communication and proactive entrepreneurship (Press and Cooper 2009).

3 An Approach to Contemporary Art as Base for Design

We consider appropriate to quote Gombrich in this encounter between art and design, for it should be addressed more frequently among the disciplines of Industrial Design, as support and cultural reference.

"Everybody who watches the contemporary scene with sympathy and understanding must acknowledge that even the eagerness of the public for novelty and its responsiveness to the whims of fashion add zest to our lives. It has stimulated inventiveness and an adventurous gaiety in art and design for which the older generation may well envy the young […]. The new tolerance, the readiness of critics and manufacturers to give new ideas and new colour combinations a chance, has certainly enriched our surroundings, and even the rapid turnover of fashions contribute to the fun. It is in this spirit, I believe, that many young people look at what they feel to be the art of their own time without worrying overmuch about the mystical obscurities contained in the preface to the exhibition catalogue. This is s it should be. Provided the enjoyment is genuine we can be glad if some ballast is being discarded" (Gombrich 2002, 616).

In the time we have been working in this specialty of products for the public use, and specifically in the course of Product and Environment Colour Design, to which we have referred in the abstract, it should be stressed that there have been several interventions of artistic nature, leading to the research and development of installations designed with shapes and compositions based on the Op-art movement as an example of the previously presented.

Given the sense of the proposals by companies and businesses, represented by the Association of traders from the historic center of Valencia, it was given a new look to the exterior and interior spaces of some of the most traditional artisan shops. The proposal to regenerate and innovate in the historic center and to create a more contemporary image to the craft-selling spaces allowed to carry on some experimental works taking as reference, among others, Victor Vasarely and the most representative works that influenced, notably, in the panorama of the avant-gardes as Groupe de Recherche d'Art Visuel (GRAV) formed by Julio Le Parc (Fig. 3), García Rossi, Sobrino, Morellet, Yvaral and Stein.

In turn, the students researched on figures as Yaacov Agam, Jesús Rafael Soto, or Nicolas Schöffer. Jean Tinguely, Yaacov Agam, Luis Tomaselo, Hugo Demarco or Apolonio Marina had some influence on the projects presented with very visual

Fig. 3 Color and light installation. Julio Le Parc, 1981 Red sphere. Tokyo Palais, Paris (France)

optical motifs, geometric compositions and well-organized perceptual interactions between colors.

We should clear that the decision to investigate and study the development of these two artistic movements, was made for their character and experimental, technical and expressive basis as well as for virtuous demonstrations of great visual impact that focus the attention of the observer. Also, we must add that, along with the pictorial or sculptural themes, we assume a conception of the spatial vision and movement, where light and color are transformed as plastic agents of great richness.

Obviously, the contribution of these two schools of avant-garde was one of the trends that influenced modern scenography, as seen in the spaces and facilities of the Foundation Vasarely in Aix-en-Provence (France) (Figs 4 and 5).

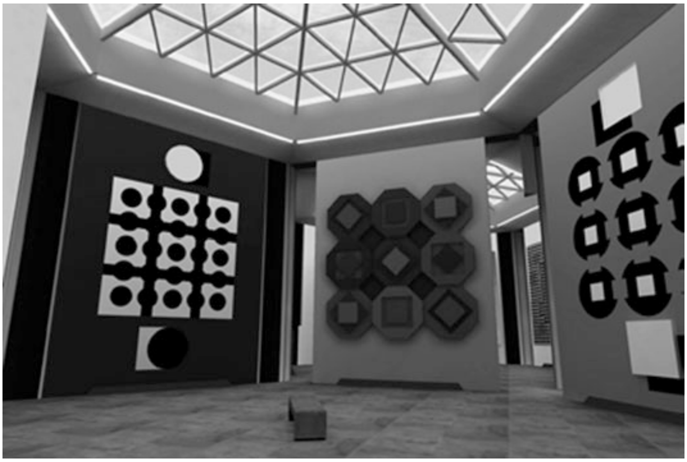

Fig. 4 Interior of the exhibition spaces of the Fondation Vasarely

Fig. 5 Interior of the exhibition spaces of the Fondation Vasarely

Concurrently to this experimental challenge of connection between art and design, we also introduce the new trends, which represented by designers as Marc Newson (Fig. 6), Sebastian Wrong, James Dyson, Fabio Novembre (Fig. 7), Ron Arad and Philippe Starck, make an impression of the most current and cutting edge.

Many of the proposals made by the students of the Master in Design have been worked and installed in the spaces selected by the shopkeepers offering a sign of sensitivity and cooperation on both sides. Thus, the social groups and partner companies help generate enthusiasm in the students of a Master, ever closer to achieve their entry into the job market. This is one of the reasons why we are

Fig. 6 Marc Newson. Bucky Chair Installation. 1995

Fig. 7 Fabio Novembre. Hitgallery. Hong Kong. 2012

committed to a learning system based on a real training project. In this sense, the training received by the students of this Master is increasingly diverse and multidisciplinary. Backgrounds from fields such as the Fine Arts, Architecture, Engineering or History of Arts, or from different countries, can expand the training activities and experiment with new actions.

Finally, it should be noted that many of the works carried out have been disseminated in social networks and exhibitions, allowing the student to interact with entrepreneurs and craft industries, providing the opportunity to continue or develop new and different designs for commercial spaces looking for innovation. Therefore, we consider that it is necessary to offer a wider cultural and creative vision, exploring more communicative proposals, conceived from art emphasizing the object, space and image (Figs. 8, 9 and 10).

Fig. 8 Work process for the installation at the commercial spaces

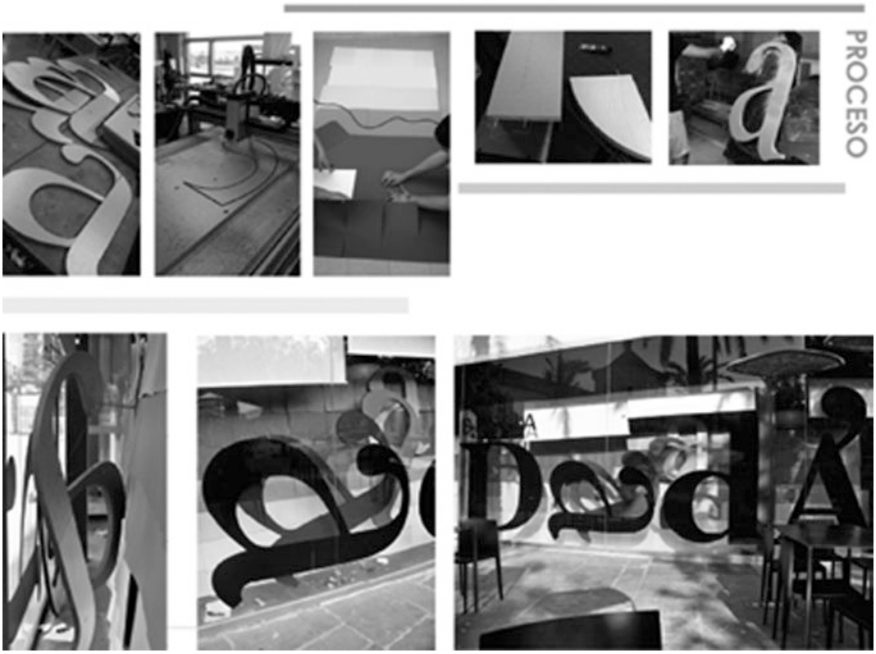

Fig. 9 Dadá bookshop at MUVIM (Museo Valenciano de la Ilustración y de la Modernidad). Work carried out by students of the Master in Design: Isabel Crespo; Edwin Genao; Joaquín Ginés; Rosa Mascarell; Aida Ramón. Construction and installation. Year 2014–2015

Fig. 10 Soriano bookshop. Historic Center of Valencia. OpArt shop-window. Work carried out by students of the master in design: Cesar Morant and Fangzhou Chen. Construction and installation. Year 2014–2015

4 Conclusions

To promote a project based on experience and interdisciplinary concepts which tries to bring a real problem into the classroom at the request of a company and use the most appropriate means, techniques and production processes.

To broaden the basis and concepts of branding techniques and methods in a project for its study, installation and communication, exploring themes closer to design for set places, delving into new themes and contexts, as well as in art and culture design as main supports for innovation.

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Puzzle Methodology in Architectural Graphic Expression. EGA 3 Examples

Taciana Laredo Torres, Ignacio Cabodevilla-Artieda and Ricardo Santonja Jiménez

Abstract This paper focuses on the planning of teaching architectural drawing (and its supplementary software tools) in the EGA 3 course, (6ECTS, 2nd Term, 1st year, Degree in Studies in Architecture at the University of Zaragoza), using experiences of active-cooperative learning, using the Puzzle methodology as a tool to build the complete learning goals. This methodology lets the student learn supported by other students, building the puzzle together. Each member of the group has a key-frame of the knowledge, so that when the team puts them together, every member of the group gets the complete desired knowledge. This way, our role as teachers is changed into that of a catalyst.

Keywords Cooperative learning · Puzzle method · Architectural drawing

1 Introduction

The inclusion of the Spanish university system in the European Higher Education Area has led in recent years to an academic revolution in which the teaching and assessment of knowledge methodologies that had been traditionally applied have been questioned. As stated in the preamble of the Organic Law of Universities, a new sort of University that would allow Universities "to address, in the context of the knowledge society, the challenges of the necessary innovation in the ways of generating and transmitting knowledge". Traditional methodologies, supported by the premise that the teacher has the knowledge and transmits it to the students, must change and pass from being the only way *to give lessons* to be just another tool in

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the classroom. The students must acquire the ability to manage their own learning process and the teacher must become a mere facilitator in this process.

In this paper we will focus on the management of an active-cooperative learning method called *Puzzle* (formulated by Professor E. Aronson at the University of Austin in 1971). Its application to the EGA 3 course (1st year-2nd term—6ECTS in the Degree in Studies in Architecture at the University of Zaragoza, whose goals are to acquire architectural rendering abilities using computer software) is a turning point both for the objective and subjective results of the students.

2 Active-Cooperative Methodology

"The transition from an educational model focused on teaching to a model focused on learning is a major *cultural change* for the University as an educational institution. Among the pillars of this change is the so called *methodological renewal*" (Fernandez 2006).

The active-cooperative methodology meets the guidelines of the credit system of the European Higher Education Area (EHEA) and—always in combination with other teaching strategies—articulates the contents and cause a significant learning of them. Learning goes from *vertical* (teacher–student) to be built *horizontally* (student–student), enhancing capabilities such as group interaction, content management by the student, detection-troubleshooting and as the students try to recompose the puzzle, they are able to explain and transmit what they have learned to the rest of the team.

According to constructivist theories (Flórez 1993), knowledge is not received passively but it is processed and actively constructed by the subject that *knows*. The pedagogical constructivism argues that human knowledge is a construction of each student in order to achieve a higher level of diversity, integration and complexity. Therefore, if human learning is an internal construction it cannot be transmitted, only *metabolized*. And it is at this point that, as teachers, we must consider our role in the classroom. Lectures, *giving class*, cannot constitute the whole of our regular work, but our lectures should support timely and minimally active methodologies that reside in the students themselves (Fig. 1).

3 The Puzzle Technique

Puzzle technique is an active methodology that allows us to structure cooperative learning. Its basic sequence is as follows:

- The theory is divided into parts and each member of the group is commissioned to become an "expert" in a part through its analysis and study of its structure (mixed work *before* the class and *in* the class).

Fig. 1 Knowledge construction according to Aronson's Puzzle method. Designed by Freepik.com

– Once this individual work of specialists in each group has been done, a gathering of every expert in each piece takes place. At that moment, an exchange of knowledge between the groups is generated (expert sessions in the classroom) with the supervision of the teacher.
– Finally, the most significant part. The group gathers again and each member explains the others the parts of the puzzle that he has worked on separately in order to build the global knowledge of the group.

Each part in which knowledge is divided into (puzzle piece) must be essential for the understanding of the final theory. As a result, the involvement and commitment of each member of the group is essential, resulting in lower absenteeism from classes and greater assimilation of the contents. No member of the group can individually achieve the global knowledge without the parts supplied by the teammates.

But… how, us teachers *owners of knowledge*, can we ignore our fabulous lectures and give the power to the students?

The main fact is to recognize that the right method lies in the students' work and not in our lessons. In order to plan the course correctly, we will consider the number of ECTS (1 ECTS = 25 h of student's work) to calculate the total time of commitment that we require from the students. We will consider both the activities in and outside the classroom. We will split the course in didactic units, and for each of them we will elaborate:

– Program objectives and basic bibliography. It should clear and detail the items on each unit, objectives and what *we expect* the students to learn. This program will help the students to self-study the matter.
– Study guide. It will explain the necessary activities in and outside the classroom to succeed in the learning process. It will include the hours of dedication that is expected for their part, the schedule of the lessons, the basic objectives and evaluation methods to be used.
– Notes from the unit. We previously elaborate concise and sufficient notes to solve the classroom activities (Fig. 2).
– Specific activities for each unit. These are the core of our methodology. Carefully planned, they can be refined as put into practice. Our bank of activities will grow while self-correcting.

After the description of the procedure we must ask how ourselves this methodological change affects the evaluation system. In this respect we must observe the following principles:

– Students' work cannot be measured objectively. We must keep it out of the assessment.
– Tests must be objective and allow the students to demonstrate their skills.
– The conditions under which the tests are performed must be carefully taken care of. If individual, there should be no transfer of information from one to another. If grouped, the groups must not interact with each other. Evaluation is not as *cooperative* as the working method (or as the students would like).
– No test should count too much towards the final grade.
– Assessment tests should be part of the learning process, taking advantage of the tension, attention and responsiveness of the students while performing them.
– To bear in mind: the average student should not be surprised, receive prior training in similar tests, and the test must relate to previously stated objectives.

If we change the methodology, should we maintain a conventional way of assessment? The theory will say that the evaluation ways change at the same time as methodology does. But we must not forget that we are at the University level, with contents that can be assessed objectively, which must be evaluated in such way.

Fig. 2 Basic phases to plan in the schedule for each activity. Designed by the authors

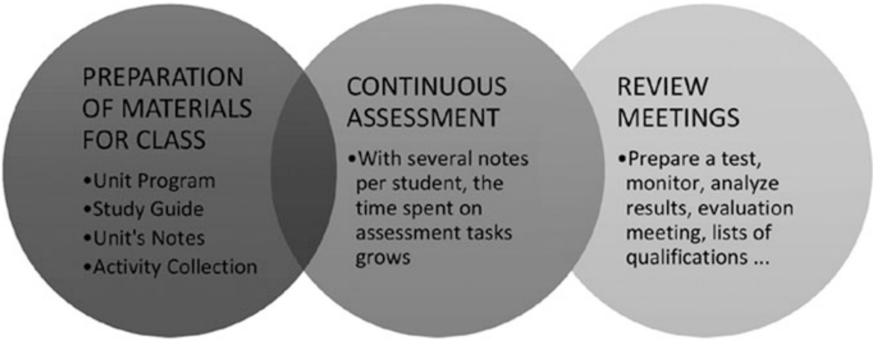

Fig. 3 Teacher's work time. Design by the authors

What we can analyze is the importance of the objective assessment within the student's grades. Lower the passing grade to 4, perform various tests throughout the course, change their methodology (rapid test at the end of the class, individual troubleshooting once the group practice is finished…), average the practices… Either way, we sincerely believe that the controversial exam may not—and must not—disappear.

We have solved two fundamental questions: How is it done? And, how is it evaluated? Another one, the most relevant in order to opt for this (or other) methodology: what results are obtained? There are several factors to evaluate a method of teaching-learning:

– Academic results: do they get better, remain the same or get worse?
– Teacher's work time. More profitable with a larger number of students. Teamwork is very important in this methodology.
– Students' satisfaction
– Procedural Issues
– Dedication of the students (Fig. 3).

4 The Puzzle in EGA 3

The EGA 3 takes 6 ECTS and covers the contents related to two and three-dimensional drawing of architectural elements. That is, the *architectural drawing* is divided into two main blocks: during the first weeks a joint approach to technical plans (plans, sections and elevations) using AutoCAD (latest version) is addressed and during the last weeks, three-dimensional software (Rhinoceros and Sketch Up) are used to complete the work and achieve the complete representation of all architectural elements through perspectives, axonometrics or infographics.

The methodology applied so far (lecture given by the teacher, individual practices by students and corrected only by the teacher) has not provided the expected learning outcomes. Therefore, after a research and training work carried out by the teachers of the course, we have proposed a number of changes in the methodology and we have included among them problem solving methods based on the Puzzle method. The implementation of this technique is based upon the detection of the need to generate a change of the teaching procedure *without altering* the contents.

La metodología aplicada hasta ahora (clase magistral impartida por el profesor y prácticas realizadas por los estudiantes de forma individual y corregidasúnicamente por el profesor) no ha proporcionado los resultados de aprendizaje esperados. Por tanto, tras una labor de investigación y formación llevada a cabo por el equipo de profesores de la asignatura, se han propuesto diversos cambios en la metodología entre los que cabe destacar la resolución de problemas basada en el método Puzle. La implementación de esta técnica se basa, por tanto, en la detección de la necesidad de generar un cambio del procedimiento de enseñanza pero *sin alterar* los contenidos.

5 Conclusions

This approach has advantages and disadvantages depending on the group of students. If we can convey the need to build their own autonomy and cooperate in the search of the contents of the course and, therefore a positive evaluation of it, we will find that the proposed methodology is much richer in nuances and learning is more meaningful and deeper than the one we were getting with traditional methodologies. In any case, this method is not all advantages as we show in the following Table as Pros and Cons of this methodology (Table 1, 2 and 3).

Table 1 Pros and cons of this methodology

Pros	Cons
– Contributes to improve student's motivation – Increased student satisfaction in relation to learning – Helps to reduce conflicts in the classroom – Promotes positive interdependence among the students – Reduced absenteeism in the classroom – Contributes to improve self–esteem, especially students with low academic performance – Produces more meaningful learning than traditional methodologies (if the student gets involved in the work dynamic)	– Lack of motivation – Resistance to change – Feeling of wasting time in the classroom – Group dynamics and personality of students: – The dominant student – The slow learner – The bright students who are bored – Students trained to compete

Developed by the authors

Table 2 Example 1 of a unit carried out with the puzzle technique

How to evaluate?
20% material prepared by each specialist to provide “his piece of knowledge” to the group. 50% group practice 30% individual objective test Therefore, 50% of the grades depends on the group and 50% of the grades is the result of individual student work
What results do we obtain?
As the experts have faced each problem individually, they are ahead of the possible difficulties of the group and explain in a clear and concise way the key aspects of their “piece of the puzzle” What can be individually meaningless, when composing the puzzle, the groups perform the practice TOGETHER and each experts controls his specialty And after the group practice will be individual examination, the commitment of each of the students’ increases Communication between students themselves is faster and more fluid than with the teacher, who must be vigilant so that the concepts are assimilated without cognitive errors

Developed by the authors

Table 3 Example 2 of a unit carried out with the Puzzle technique

How to evaluate?
30% material prepared by each specialist to provide “his piece of knowledge” to the group 50% group practice 20% group test Therefore, 70% of the grades depends on the group and 30% of the grades is the result of individual student work
What results do we obtain?
The students are members of an architectural practice and must submit the problem for publication. Their involvement grows when they consider the issue as a real and potential problem It is impossible to solve the exercise individually or fragmenting it. It must be controlled at all times by the three team members. If a student misses a class the team is penalized, reducing absenteeism

Developed by the authors

Example 1 Plans and sections: coherence and hierarchy

How is it done?				
Concepts	What is a **plan**? Expert 1	What is a **section**? Expert 2	What are **hierarchy** and graphic **COHERENCE**? Expert 3	
Group	Three people teams. Distribution of roles			5' class
Explanation	The teacher outlines the main objectives of the unit and provides the groups of experts with the basic bibliography and documents			20' class
Task **A**	Analysis of the documentation by expert 1: PLAN	Analysis of the documentation by expert 2: SECTION	Analysis of the documentation by expert 3: HIERARCHY and COHERENCE	90' home 10' class
Task **B**	Meeting of specialists. One teacher supporting group of experts. Explanation of concepts.			20' class
Task **C**	Expert 1 explains his team what a **plan** is	Expert 2 explains his team what a **section** is	Expert 3 explains his team what **hierarchy** and **coherence** are	30' class 30' home
Practice Exercise TEST	Development of a plan and section (under the concepts of hierarchy and coherence) of a home of a renowned architect in the recent history of the architecture chosen by the team.			90' class 180' home 90' Class
Sharing	Presentation of the results of each team to the class. General and specific remarks.			30' class
Self evaluation	Once the objectives are clear after the comparison of the results of all groups, each one must fill in the self-assessment form, which contain subjective impressions and an objective numerical score.			5' class
Unit's total time				300' class 300' home

Example 2 Introduction to cad software: autocad initiation

How is it done?				
Concepts	**Drawing** and **layers tools** Expert 1	**Modifying** and **properties tools** Expert 2	**Display** and **printing** tools Expert 3	
Group	Three people teams. Distribution of roles			5' Class
Explanation	The teacher outlines the main objectives of the unit and provides the groups of experts with the basic notes and websites Basic introduction to the program and files.			20' class
Task **A**	Analysis of the documentation by expert 1: **drawing** and **layers tools**	Analysis of the documentation by expert 2: **modifying** and **properties tools**	Analysis of the documentation by expert 3: **display** and **printing tools**	120' home 10' class
Task **B**	Meeting of specialists. One teacher supporting group of experts. Explanation of concepts			40' Class

(continued)

Example 2 (continued)

Task **C**	Expert 1 explains his team the **drawing** and **layers tools**	Expert 2 explains his team the **modifying** and **properties tools**	Expert 2 explains his team the **display** and **printing tools**	30’ class 30’ home
Practice exercise	Drafting of a geometric exercise hand-drawn in EGA 1 using all the above mentioned tools. Delivery: PDF and printed.			20’ class 120’ Home 50’ Class
Test	As a team, multiple-choice test on the tools and their main utilities.			30’ Class
Sharing	Presentation of the results of each team to the class. General and specific remarks.			30’ Class
Self evaluation	Once the objectives are clear after the comparison of the results of all groups, each one must fill in the self-assessment form, which contain subjective impressions and an objective numerical score.			5’ class
Unit’s total time				240’ class 300’ home

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Drawing and Mathematics. An Integrated Teaching

Alberto Lastra Sedano, Manuel de Miguel Sánchez, Enrique Castaño Perea and Ernesto Echeverría Valiente

Abstract In 2011 it was started, at the School of Architecture of Alcalá, a new course called: *Taller de Dibujo II*. Its main goal was to convey the importance of studying an architectural object from different points of view. The link would be the geometry, the coordinated subjects: design and mathematics. Teachers from both departments began an integrating task. They had two different ways of understanding teaching. It would be a subject in constant evolution. So we started an educational innovation project, which is ongoing (UAH/EV519). In the last ten years the importance of the parameterization has grown significantly in fields like design, engineering and architecture. Our School of architecture implemented an interdisciplinary group that was able to introduce these new skills. "The rigorous parameterization requires the assimilation of concepts much closer to mathematic geometry and software programming" (Coloma and Mesa in Revista EGA 19:200, 2012). But some experiences around the subject have put their emphasis on tools, neglecting, in our opinion, the methodological basis. Although traditional teaching materials are not fully useful to this new subject, accumulated experiences are very valuable. Grassa-Miranda and Giménez (Revista EGA 15:156, 2010) regarding the traditional teaching of geometry states that "The grammar or guiding principles of the Spanish *sistema diédrico* uses the projective schema of a model to build the student's spatial thinking, while the Anglo-Saxon direct method relies on the

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reconstruction of a mental image of the geometric configuration" In a similar way, we considered the importance of the object opposite to the system, or the process. Therefore, the starting points of our methodology are the works of architecture and engineering. Objects with a complex geometry, especially those which curves and surfaces are able to be parameterized. The curve and surface become that way, protagonists of the experience. The next step is to thoroughly analyze through operations of modification and intersection. A good analysis of a work with a complex geometry, involves the preliminary study of the project and the knowledge of the difficulties and intentions of the author. Often the most interesting geometric designs arise from the need of finding creative solutions for complex problems with the most simple and balance response, as a whole. Many of the works built by Torroja, Candela, Dieste, Maillart, Isler, Freyssinet, Frei Otto, Fisac and many others, show that the study of the object cannot be limited to the representation of form. In this article we will show our experience and several possibilities to develop about the subject. We will describe the overall strategy and present some concrete exercises defining our scope. Finally we will propose several alternatives for further applications in future editions of the course.

Keywords Teaching of geometry · Architectural geometry

The traditional teaching of geometry has relied on the use of abstract objects, such as points, lines, planes, boxes, cones, cylinders, etc. Maximizing the reduction of elements involved in a problem the student focuses better on general concepts. Therefore the exercises are structured so that any complex problem can be divided into several smaller difficulties, each of which are available to the student in separate procedures. This approach currently continues forming an important part of the basic teaching of geometry. Although it provides an enormous instrumental power, it develops disjointed skills and lacks a deeper insight into the architectural object as a complex geometric project. We introduce the case study as a primary means of applied knowledge.

The methodology known as problem-based learning (PBL) is suitably adjusted to the guidelines of this research. This consists on the proposition of problems as a starting point for the acquisition of new knowledge. PBL boosts self-learning, skill development, motivation, empathy and respect between individuals. It takes place in three stages: starting stage, where the prerequisites, resources and partial goals are identified, second stage, implementation, in which the partial goals lead toward the final Project, and the final stage, where conclusions are made after completing the project and the final feedback (Agudo 2010).

Taller de Dibujo II is a subject aimed to the study of geometry, at the second course of Architecture's degree. So we can count on the knowledge gained in the first year and then progress modelling complex real projects. For this we rely on computers. There is a number of software in the fields of design and mathematics that allows all kinds of modelling, but in order to use them efficiently a good knowledge of geometry is essential (Pottmann et al. 2007).

Architecture and engineering provide us a big number of examples to study, objects of complex geometry, especially interesting are those with parameterizable curves and surfaces. About this issue we agree that "The true idea of parametric architecture is far from projects as a performance" (Viamonte and Peinado 2014) and therefore the goals of the analysis must be defined clearly, focusing on the relationship with its geometry.

Polyhedra are very interesting objects for architecture and construction, mainly because of their possibilities to be understood as a set of planes and lines. Given that simplicity, from the geometrical point of view, such objects have a lower formal complexity and therefore are less interesting than curves and surfaces, which become main characters of the experience. The great contribution of mathematical knowledge applied to this matter, is that it allows the student to determine the variables that define the forms, it is what characterizes them radically since their inception. The mathematical formulation let us identify the precise parameters of a curve or surface, and then we approach through the numerical abstraction. Mathematical geometry and programming eases rigorous approach to the study of the object (Coloma and Mesa 2012).

The next step is to thoroughly analyse through operations of modification and intersection. Once solved the basic classification of lines and surfaces, learned in previous courses of geometry, then we start to comprehend the details. The analysis descends from absolute abstraction to features that materializes the architectural or engineering object. For example a vault can be understood first as intersection between cylinders, but then we need to think about the construction process, traces, stereotomy, etc. Another example is the definition of the thicknesses that leads to the construction of a concrete shell. The model is constructed from the geometry of the object, The three dimensional model is a container of information (García Reig 1999b), the levels of definition match the deepness that requires the research, from the purest abstraction to the most concrete detail.

The study of the object can not be limited to a simple reproduction of the form. Analyzing a work of complex geometry requires to study the project. In Taller de Dibujo II we start investigating about the authors and the circumstances of the works. The collection of graphic information, both photographs and drawings, allows the students to enrich their bibliographic memory and focus their formal interests for future projects. On the other hand, the history of construction, knowledge of the people involved in the genesis and development of the project, help to understand the magnitude of the solutions (Castaño Perea et al. 2014).

The most geometrically interesting designs arise from necessity. The search of solutions beyond the limits of the possible boosts the designer's capabilities and use to provide technical and artistic innovative solutions (Llorente Zurdo et al. 2012). This architectural culture includes authors of great interest for their expertise on geometry and construction. Many of them are architects not sufficiently valued by the students of first courses, such as Felix Candela, Miguel Fisac and Emilio Pérez Piñero.

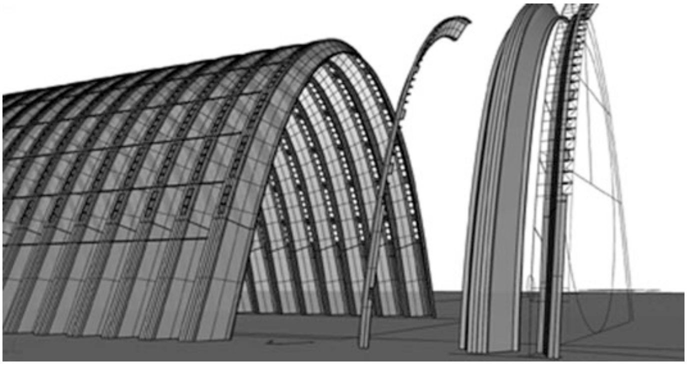

Fig. 1 Eugène Freyssinet, 1923, *Hangares de Orly*, France

But the highlight part of this subject, in the Degree of Foundations, has been the recognition of the great engineers' achievements. Contributions to the field of architectural forms through the works of Eduardo Torroja, Eugène Freyssinet, Eladio Dieste, Robert Maillart, Heinz Isler, Frei Otto, etc. that act as exceptional configurations of spaces. They provide us magnificent structures that dominate gravity thanks to a strict control of their geometry and transform radically the contemporary architectural scene.

Mentoring is a fundamental support from the teacher to the student and it becomes an monitoring base for academic process. This is implemented in the initial planning of the course, based on the competencies of both, the mentor and the student. We regard mainly the skills of effective communication, conflict management, planning and teamwork (Castaño 2012).

In this article we show models developed during the past year. The order of pictures is directly related to the study of the geometric elements in mathematical classification. Thus the course began with the parametrization of plane curves then continued with curves in space and finally we take examples of surfaces, both quadrics and warped surfaces, as well as ruled surfaces and networks of curves (Fig. 1).

1 Curves

The three dimensions are equally important for understanding the structures and constructions. But we can speak about linear and surface structures, thus it means that one dimension is less important than the other two, concerning their geometry. The definition of curves of the arcs is a significant source of models for the course "if the column is art, the arc is technique" (Torroja 2000). Our studies of these elements are based on the parameterization of the different curves. Anyway we do not lose sight of their constructive and structural meanings. The arc is always associated to the wall to carry loads to the foundations, besides it provides a remarkable control of the proportions. The beauty and understanding of the cycloid whose proportions are set by its definition, that refers to this mathematical concept. On the other hand, exempt arches change their shape to fit the path of the forces, so the parable is adapted to the anti-funicular curve.

The parabolic guideline in exempt arches is a symbol of modern engineering. Starting with the studies carried out by Giovanni Poleni (1683–1761) about St. Peter's dome in 1748 (Heyman 1999), through many bridges arches in the nineteenth and twentieth centuries, as well as the great Gateway arch, of Eero Saarinen in St. Louis, Missouri, completed in 1968, the power of forces has enriched the built panorama with these curves, structurally pure and attractive formally.

The hangars for dirigibles, made by the French engineer Eugene Freyssinet in 1923, in Orly, and destroyed in the Second World War, are a powerful example of covered space with a vault of parabolic guideline. The vault is a folded sheet of 86 m span and barely 9 cm thick. The wave has a variable width from 5.4 m at the base to 3 m on the upper part. This impressive structure is possible thanks to its shape. It needs to neutralize its weight and resist winds, so it have to increase the inertia through the ripple of the shell. Studying this work allows us to explain the possibilities of parables on arches, as well as thinking about the complexity of the structural problem of a very bold solution.

About three dimensional curves, helix is a remarkable case. A curve associated with interesting buildings, among which highlights The Minaret of the Great Mosque of Samarra (850), the Solomon R. Guggenheim Museum in New York (1959) by Frank Lloyd Wright. And also we can study the double helix of the dome of the German parliament, by Norman Foster, completed in Berlin in 1999. This shows a transparent space, which convey a sense of dynamism. It is configured as two twisted ramps, one for going up and one for going down. The problem is that the helices are not built over a cylinder or a cone, but they are projected onto an ellipsoid, generating a space visually better controlled.

2 Surfaces

The ruled surfaces are very important for architecture and engineering. In addition to the cylinders, mainly linked to the intersection of their curves, we find the conoids, cylindroids, helical, etc. About them the student must understand how the guideline curves are connected, creating radically different surfaces depending on the relationship with an axis, a plan, a vertex, etc. (Figs. 2 and 3).

In 1939 Robert Maillart build a main hall pavilion at the National Exhibition in Zurich as a Portland Cement propaganda. A shell of 6 cm thick. After the fair the concrete structure was tested until failure and disappeared. In this case the shells are limited by different parabolic guidelines curves and ruled surfaces have interesting nuances depending on how they are generated.

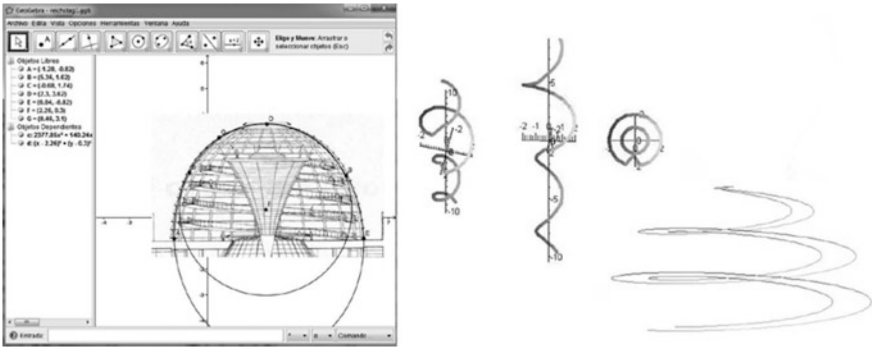

Fig. 2 Norman Foster y Partners, 1999, *Cúpula del Reichstag*, Berlin, Germany. Curve related to the model parameterization

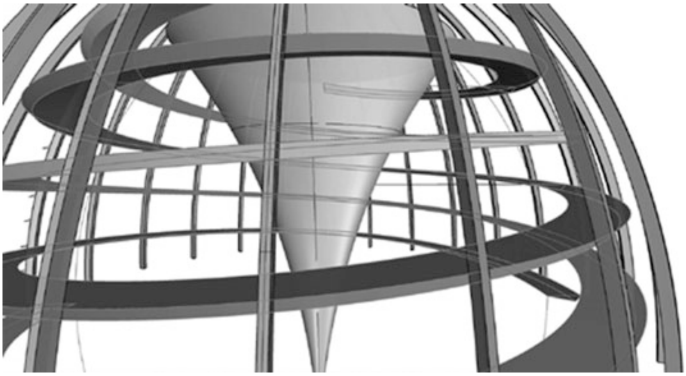

Fig. 3 Norman Foster y Partners, 1999, *Cúpula del Reichstag*, Berlin, Germany

Ruled surfaces in construction provided the possibility of relying construction on straight lines. However there are many other works that use other warped surfaces that do not have these possibilities. These surfaces are understood as networks of curves in different planes. Such is the case of the Church of Atlantis, the parish of Cristo Obrero, Montevideo (1952), by Eladio Dieste. Here we can see the Vaults called Gausas. On a rectangular fl the walls and roof are ondulated. Dieste uses sinusoidal curves on the sections of the dome to shaping it as a catenary that eases the path of forces through the structural elements. Use the structural ceramics (Mas Guindal and Adell 2005), reinforcing the brickwork in two directions, taking advantage of the joints between bricks to put the rods of iron. The horizontal forces of the vaults are balanced by the steel braces inside the surface.

The geometric analysis of this work is closely related to the curves of its plan and section and the surfaces generated in the combination of both of them.

Although our analysis is not structural, distribution of metal reinforcements is present in it because of the link of forms and forces through geometry (Figs. 4 and 5).

One of the most complex examples that we have developed in last years is the Tribuna del Hipódromo de la Zarzuela, by Eduardo Torroja. In the section we can see a composition of different surfaces in a perfect balance. Cylindrical and toric vaults of the lower spaces are opposed to the "mainly hyperbolic" vaults of the cantilevered roof (Chías Navarro 2005). Eduardo Torroja designed this work according to the laws of statics, he modeled the structures in order to control the forces in space and always through a thorough and strict investigation of the alternatives, with a clear intellectual understanding of the problems in every meaning (García Reig 1999a) (Figs 6, 7, 8, 9 and 10).

Torroja is an engineer and entrepreneur, son of a mathematician, represents the ideal of linking research and industry (Andrade Perdrix 1999) his work combines

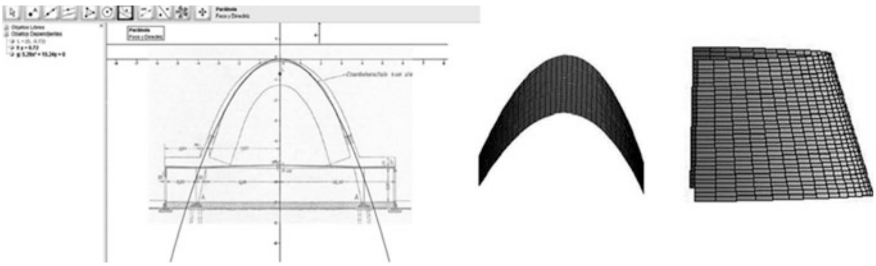

Fig. 4 Robert Maillart, 1939, *Cementhall* Pavilion, Zurich, Suise. Surface developed from the model parameterization

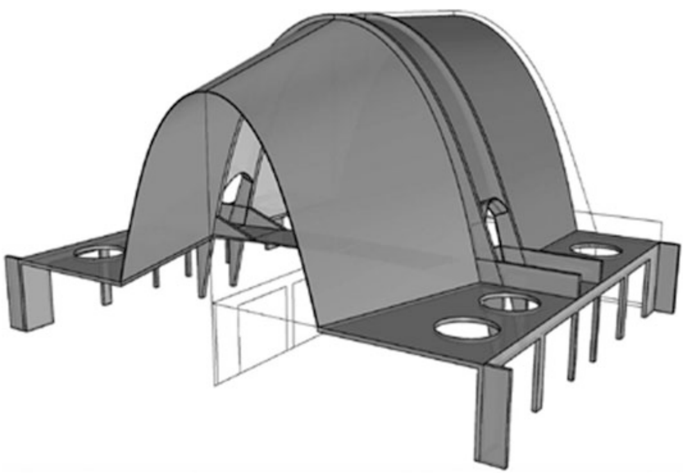

Fig. 5 Robert Maillart, 1939, *Cementhall* Pavilion, Zurich

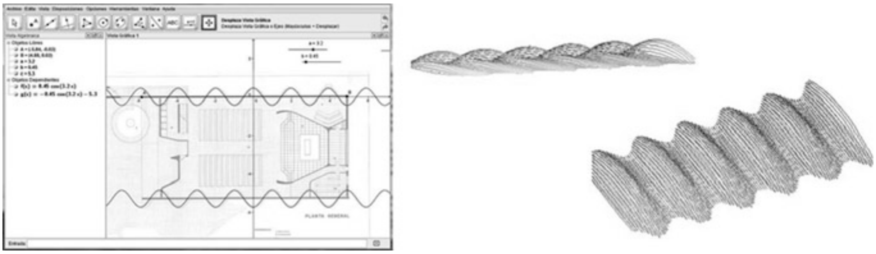

Fig. 6 Eladio Dieste, 1952, Iglesia de Cristo Obrero, La Atlántida, Montevideo, Uruguay. Surface developed from the model parameterization

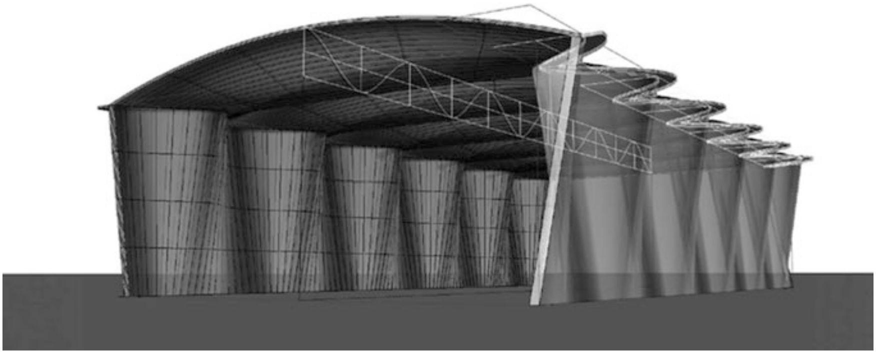

Fig. 7 Eladio Dieste, 1952, Iglesia de la Parroquia de Cristo Obrero, La Atlántida, Montevideo, Uruguay

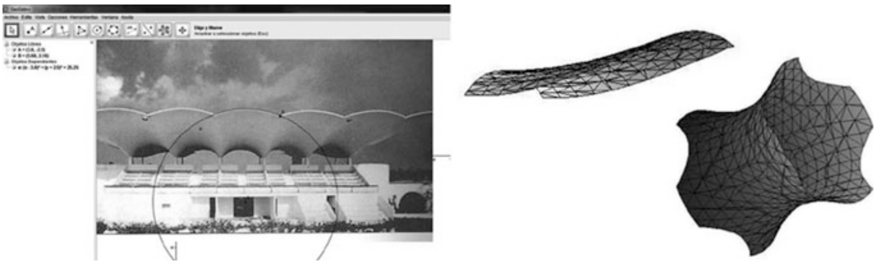

Fig. 8 Eduardo Torroja, 1935, Tribuna del Hipódromo de la Zarzuela, Madrid. Surface developed from the model parameterization

mathematical theory and graphical construction. Taller de Dibujo II try to learn from this mixture. There are many others structures of similar character, new opportunities to explore innovative configurations from the point of view of their geometry, proving how important it is knowledge, for projecting, building and comprehend these objects.

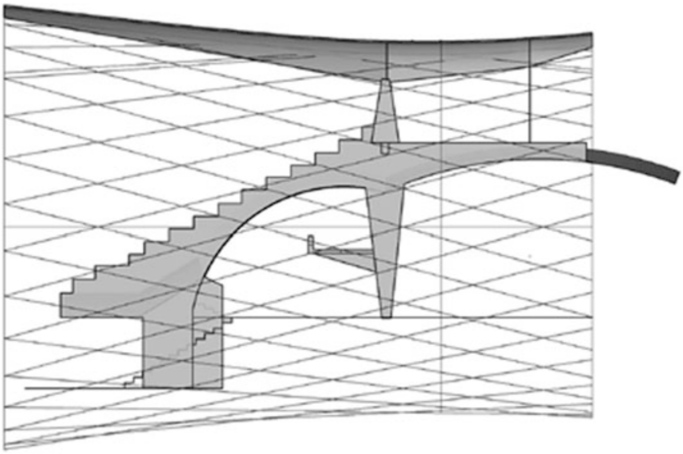

Fig. 9 Eduardo Torroja, 1935, Tribuna del Hipódromo de la Zarzuela, Madrid. Hyperboloid designed according to the upper face of the concrete shell

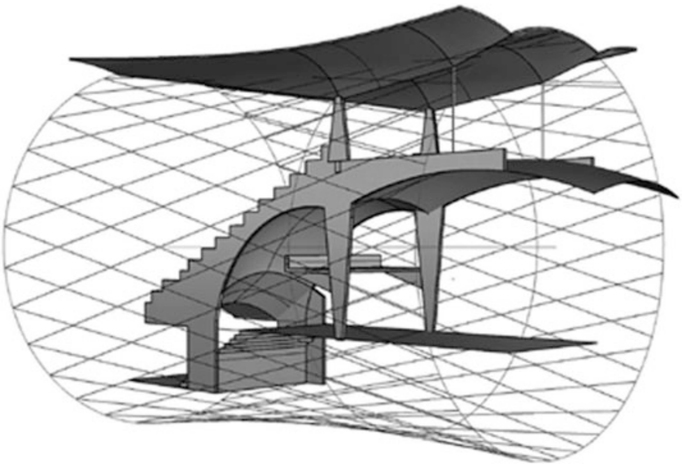

Fig. 10 Eduardo Torroja, 1935, Tribuna del Hipódromo de la Zarzuela, Madrid

3 Conclusions

This experience has reached its fifth edition. Throughout these years we have made a significant number of analysis similar to those we show in this paper, providing the students an catalogue of different cases. We have focused on operations with abstract forms and transformations. These configurations are commonly implemented in many architectural and engineering structures.

The strategy of problem-based learning has given to the students tools for geometric analysis. The managing and the level of definition of the drawings have been adapted according to the exercises. The teachers have encouraged the students to create their own geometric project, where they can schedule their learning path, with the support of the teachers according to the referred methodology.

These courses have led us to focus on making precise geometrical analysis, working with to very specific objectives. Our scope is to select the necessary geometrical information, avoiding other visual features, mainly photorealistic pictures, which according to our experience, may be a distraction for the analysis of the models.

In the medium and long term that subject is already producing interesting effects. In other areas, at the School of Architecture, the number of projects with complex geometry and parameterized elements are being multiplied.

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Enrique Castaño Perea Ph.D. in architecture from the Polytechnic University of Madrid (2007) and MBA at the European University of Madrid doctor. He is university professor since 2003, teaching drawing and architectural projects. He is currently Professor in the Department of Architecture at the University of Alcalá. He researches and works on image as a tool for architecture, focusing both historical and educational drawings since the Renaissance to the present day. Likewise treatment of image as a resource, applied in the field of architecture for diagnosis of deficiencies in buildings and augmented reality technology applied to archeology.

Ernesto Echeverría Valiente Architect from ETSAM (UPM) since 1990 and a Ph.D. in architecture since 2005, obtaining Cum Laude for his thesis "The university campus of Alcala de Henares: analysis and evolution." Professor in Architectural Graphic Expression since 2008. He is currently Director of the Department of Architecture at the School of Architecture of the University of Alcalá. He is the principal investigator of the Group of the UAH in the research project "Integrated System for energy optimization and reduction of CO^2 footprint in buildings: Technology BIM, Indoor mapping, UAV and energy simulation tools."

Singular Drawings: A Motivating Exercise

Aitor Goitia Cruz

Abstract Outstanding draughtsmen have drawn unique visions of great buildings projected by others. Encouraged by their example, at the Escuela Politécnica Superior, we have consolidated a satisfactory exercise in which second-year students must face a similar task: to plan and develop a freely-chosen ambitious personal drawing that expounds the significance of a thoroughly studied architectural model. The goal of this paper is to show some of these unique drawings while highlighting their developmental process, which is both extremely challenging and rewarding for the students, who achieve outstanding levels of graphical ability and architectural interpretation.

Keywords Singular drawing · Motivation · Interpretation

Hugh Ferriss (1889–1962) translated into architectonic poems the volumetric restrictions by which the zoning law of New York regulated the construction of tall buildings in 1916. The four drawings published in the New York Magazine in 1922 constitute one of the most influential architectonic references of the past century, and their seductive facture has been a recurrent fount of inspiration for posterior generations. The initiative of realisation had come from Harvey Wiley Corbett, an outstanding projector of skyscrapers. Corbett, as so many others, was interested in the interpretation of a norm which would dictate the necessary recesses to guarantee the entry of light and the circulation of air into the streets of the city. Thanks to Ferriss, the rugged rules of the new regulations were transferred into an attractive formal purity drawn in four stages, which pointed to the germinal idea of a new architecture for this unequaled North American city.

The author himself included this series in his most remembered work, *The Metropolis of Tomorrow* (1929), where visionary scenes of future cities share protagonism with the most outstanding architecture of that time. The striking views

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of the Chrysler Building, the Bank of Manhattan, the Daily News or the tower of the Chicago Tribune equally distill the technical skill and interpretative capacity of a Hugh Ferriss who would receive requests to represent the projects of diverse architects in such a stimulating way during the following decades.

Along with the evocative drawings of Ferriss, we also remember those of John Wenrich (1894–1970) for the Rockefeller Center, projected by Raymond Hood. Following his trail, illustrious draughtsmen, such as Carlos Diniz (1928–2001), Helmut Jacoby (1926–2005), and Stevenson Oles (1936), have contributed notably to the recent history of Architecture with their work for Minoru Yamasaki, Skidmore Owings and Merrill, I. M. Pei, Philip Johnson, Kevin Roche, Frank O. Gehry, Cesar Pelli or Norman Foster, among others (Figs. 1 and 2).

At first sight, the fact that outstanding architects, extremely gifted in drawing, recur to colleagues in the representation of their architectures may result disconcerting, as the history of Architecture is full of drawings where the author tries to persuade the world of the validity of his project. Who could do it better? Isn't it the architect who most intimately and profoundly knows the keys to his architecture? Perhaps this second question suggests a response to the first, as the total implication of the author may condition his discernment at the moment of communicating his

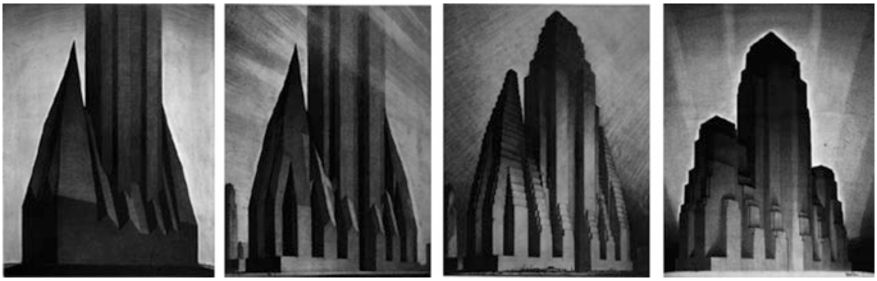

Fig. 1 Hugh Ferriss, 1922: study for the maximum volume permitted by the Zoning Law of New York in 1916. *Cooper Hewitt Smithsonian Design Museum*

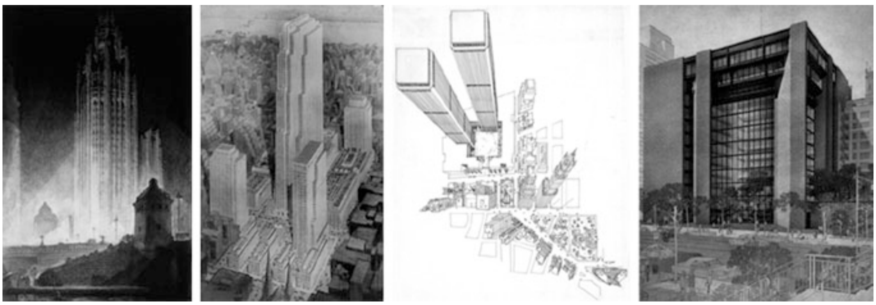

Fig. 2 Hugh Ferriss, 1927: Chicago Tribune Tower (Howells & Hood). John Wenrich, c.1935: Rockefeller Center (Raymond Hood). Carlos Diniz, 1965: World Trade Center (Minoru Yamasaki). Helmut Jacoby, 1965: Ford Foundation (Kevin Roche)

work. In the same way that the interpretation of the Sonata D960 by Elisabeth Leonskaja may move our spirit far away from the victories and defeats of Schubert during its composition, the authorship of an architectonic project does not assure full success at the moment of exposing its attractiveness, perhaps brilliantly interpreted by third parties.

Those who require the services of qualified artists to represent their works deposit absolute confidence in them, not only in the technical realisation of the work, but also in the adequate interpretation that should reign over the election of systems, recourses and techniques with which to illustrate an architectonic project. The necessity of anticipation of the execution of the work usually determines most of these achievements, tending to recreate the formal nature or space of the project with a realism capable of bringing to the observer a future reality, understandable only through the drawing. Therefore, exterior and interior perspectives, where the election of settings, points of view and chiaroscuros approximate the real experience of living the city and the architecture. In this respect, Oles (1988, xii) argues for the utility of these representations, susceptible to being compared to the photographs taken after the construction of the building. Spared from such scrutiny, graphic contributions such as perspective cross-section, are used with relative frequency to illustrate the qualities of a projected or constructed work.

The Museum of Art of Portland (I.M. Pei & Partners), the Bulova watch factory on Long Island (Croxton Collaborative) or Columbus Center of New York (Moshe Safdie & Associates) were interpreted by Steve Oles with the wise introduction of the third dimension of the vertical section of these architectures. The recourse used in his drawing for the Design Center in Houston (devised by Cambridge Seven Associates), where the principal spatial relationships that articulate a building of great expanse and complexity, is of special interest (Fig. 3).

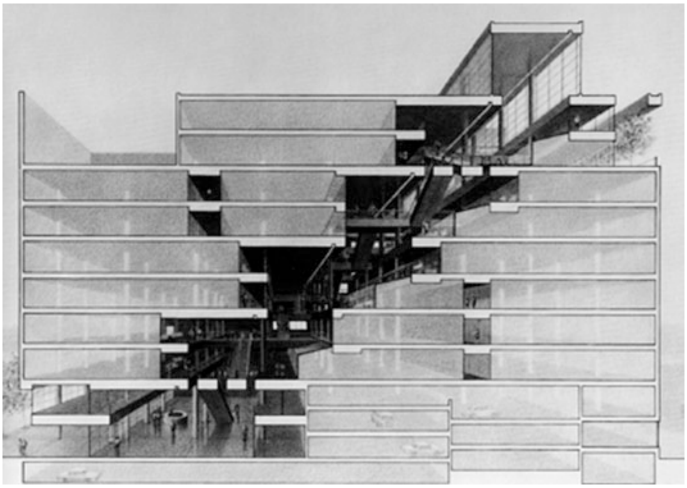

Fig. 3 Paul Stevenson Oles, 1981: Houston Design Center (Cambridge Seven Associates)

The precise knowledge of the project that others share does not seem sufficient guarantee that its essence be extracted with the lucidity of Oles. His particular reading offers us objective general information, brought to view by the cross-section plan. The veil with which he attenuates the less relevant spaces introduces us, in contrast, to the authentic treasure of the building, the linking of its related spaces. The key to the interpretation of the drawing thus acquires its true dimension, allowing the sketcher to make decisions conducive to exalting or relegating diverse aspects of the same reality, constructed or not. The special attention paid to some elements more than others is transferred in a natural and effective way to the spectator, who assimilates the qualities of the project through the eyes of the draughtsman. The distance between the author and the interpreter permits the latter to approximate the architectonic project, divested of previous conditions, in order to accurately choose the preferable points of attention and the manner of representing them graphically.

The double challenge of selecting an architectonic plot and elaborating its graphic expression is only resolved if the interpretive acuteness and the skill in the technical realization come together. Probably the masters previously cited were considered so by the unquestionable quality of their work, beginning with impeccable perspective constructions intentionally chosen and dealt with. The catalogue edited for the exposition in homage to Helmut Jacoby (Bofinger and Voigt 2001) contains numerous examples of preparatory drawings and their final results that permit one to intuit the process of formalisation of such singular creations of the German architect and illustrator, elaborated, as in the anterior cases, following manual procedures (Fig. 4).

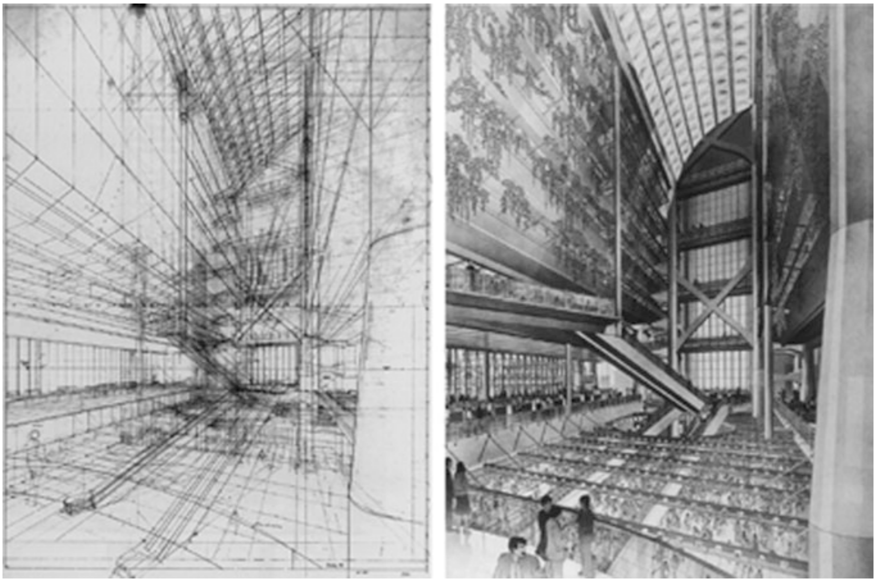

Fig. 4 Helmut Jacoby, 1982: Hong Kong and Shanghai Bank (Norman Foster & Associates)

Currently, the processes for the construction of a visual model have been almost generally replaced by computer applications, which facilitate the rigorous tridimensional determination of the architectonic project. In the same way, the application of light, shadow, chiaroscuros, and environmental elements is accomplished by software, accessible to practically anyone interested in the subject. The road to construction and graphic valuation thus smoothed in its technical slope, present and future proposals should rest more on the interpretative capacity of the project by the author and in his adequate criteria to manage the potent recourses available.

Such is the proposal of a satisfactory exercise consolidated in the Escuela Politécnica Superior de la Universidad CEU San Pablo, where second year students must propose and elaborate an ambitious personal drawing which, freely chosen, displays the interest in an architectonical model which has been minutely studied before. The process of gestation and development of a drawing of these characteristics, in spite of its exigency, becomes highly motivating for the student, previously instructed in the basic aspects of architectonic drawing.

Despite the restrictions of the recent study plans that seem to have limited the objectives of graphic formation of students in the learning of essential questions in record time, it seems convenient to slow down in a second stage, before more exigent conceptual problems of analytic indolence. Intentional representations of architecture appear with more elaboration and personalisation than the merely conventional documentary contributions. It is in this formative concept where the interpretative challenge of an architecture of relative complexity becomes more interesting, leading the student to adopt reflexive and investigative attitudes towards the expressive possibilities of architectonic drawings.

Therefore, after the first exercise introduces the student to the analytic field of architectonic drawing, we propose a twelve-week study of a middle-sized construction of public use. The complete exercise includes the analysis of the implantation and formal, spatial and functional questions of the building. These must be accompanied by certain basic documentation and the student's personal interpretation of some particular aspect in a large-sized drawing. To carry out the latter, approximately four weeks are reserved. References to Ferris, Wenrich, Diniz, Jacoby, Oles and the others alluded to are the keys to the approach and development of a deliberate graphical representation. There are no obligatory restrictions other than the mandatory three-dimensionality of the drawing and its execution for a printed edition in a DIN A2 or similar format (Fig. 5).

The Drawing and Illustration ABC Museum of Madrid, the Archeology and Fine Arts Museum of Zamora, the Art Center of Caja de Burgos, The Joan Miró Foundation of Barcelona and the CaixaForum building in Madrid have been chosen as case studies for the last five courses. All of them have satisfactorily fomented the analytical and expressive capacities of the students while expressing their architectonic qualities.

From the original tentative sketches, to the refined final realization, the student must choose by himself the supports, instruments, systems of representation and graphic recourses which each phase of the elaboration of his personal plan requires,

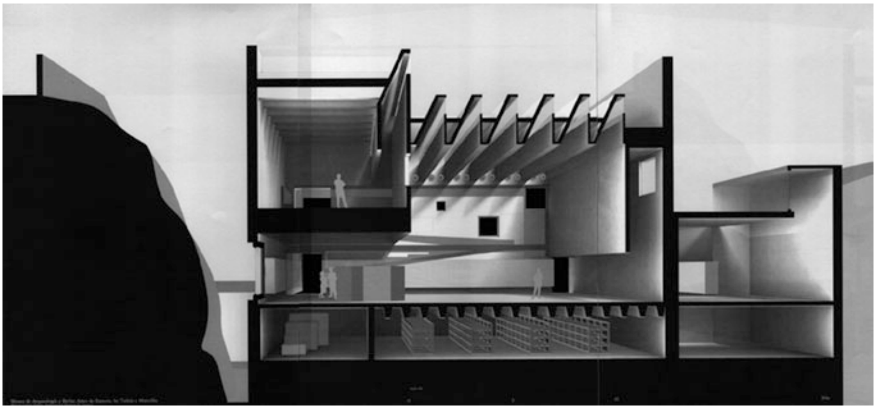

Fig. 5 Archeology and Fine Arts Museum of Zamora, interpreted by Miriam Cortizo

born of the personal reading of an architectonic model common to all of the students. The points of interest are not always coincident and, in case of being so, the different election of projections and assessment will determine the personalisation of these approximations. Views abound, perspective cross-sections, and, different to the illustrious draughtsmen mentioned, axonometric drawings appear quite frequently (Fig. 6).

In all of these works, marked or subtle references are incorporated to elements not initially seen in the system, point of view or recession elected. These are recuperated through transparencies and necessary restitutions to emphasise or complete aspects desired by the student. These decisions form part of a prolonged, continuous process whose phases could be synthesised as: proposition, graphic construction and final appreciation of a significant aspect of an architectonic model (Fig. 7).

Initially, one cannot venture firm decisions about the fragment to emphasise or the way to achieve this. A phase of previous sketching, in which the student must explore his own interests and possibilities, is necessary. It is relatively frequent that some students begin their approach from the system of representation that they believe they dominate. Experience dictates that it is highly recommendable to insist on architectonic reasoning over geometric construction, although one is finally supported by it. In addition to the systems and points of view adopted, the graphic manipulations, which will transfer the plan chosen to the observer, must be practiced from the first sketches.

Starting with a sufficiently appraised proposal, one must tackle the graphic construction of the visual model with certain guarantees of undertaking a laborious work in the adequate direction. In spite of these precautions, the drawing itself will dictate guidelines and solicit answers perhaps not anticipated in the original

Fig. 6 Drawing and illustration ABC museum of Madrid, interpreted by Carmen Rubio

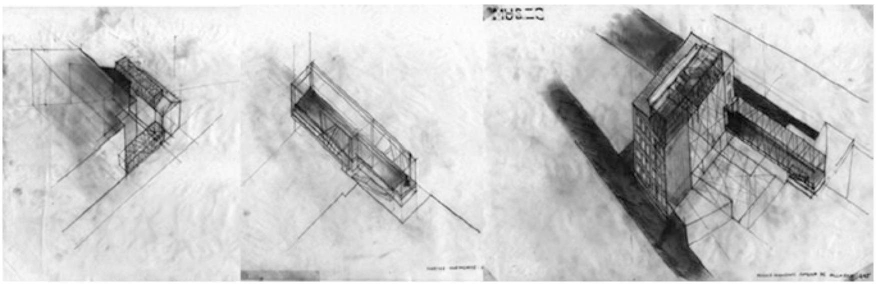

Fig. 7 Drawing and Illustration ABC Museum of Madrid, initial drawings by Nieves Clemente

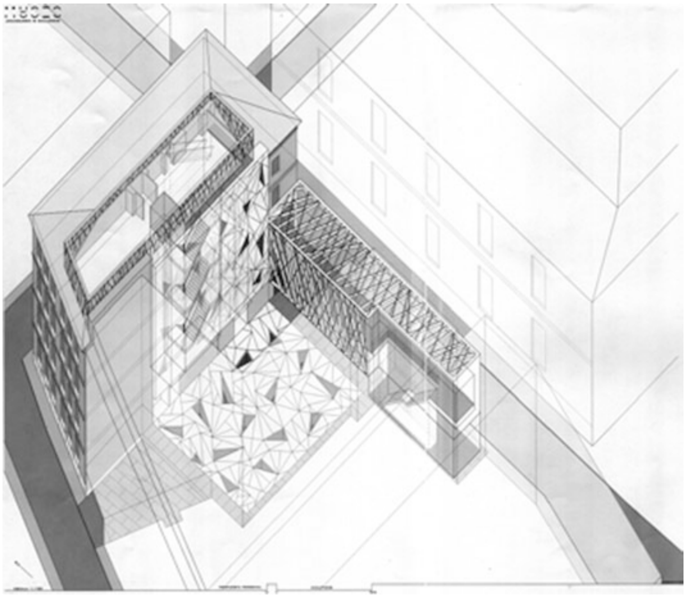

Fig. 8 Drawing and Illustration ABC Museum of Madrid, interpreted by Nieves Clemente

approach. It is a process of continuous production and reflection, tutored by the professors and shared with the rest of the students until its final conformance.

The variety of answers in the different groups of students evidences the multiple lectures that we may extract from the same architecture, depending on our own interests and intuitions. Thus, the personalisation of the concept and realisation of these singular drawings is intensified. Practically all of the students recur to assisted drawing to construct the tridimensional model, as well as by the precise treatment of images. Left behind are the carbons, graphite, waxes, pens y water-colours of Ferriss, Oles or Jacoby, whose architectonic interpretations continue to inspire professors and students in a constant interchange of ideas in this exercise, capable of intensifying individual learning and group experience to achieve high levels of graphic competence and architectonic interpretation (Figs. 8 and 9).

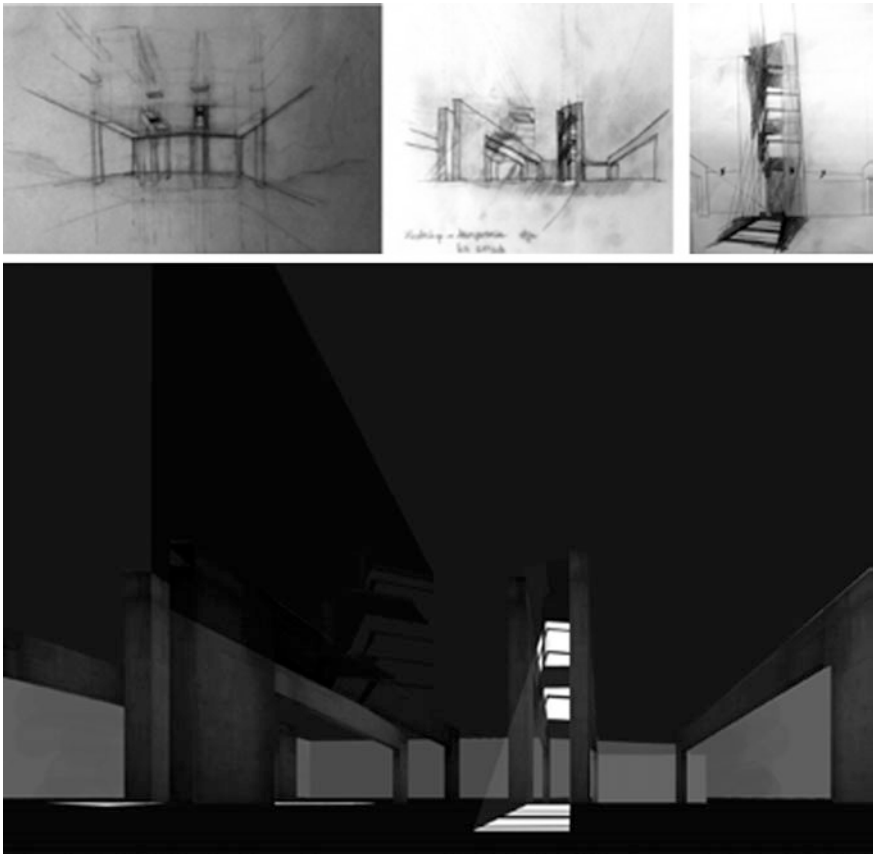

Fig. 9 Art Center of Caja de Burgos, initial sketches and final interpretation by María Mateos

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Pictures of the Territory and the Landscape: Cartography and Drawings of the Mountains of Guadarrama

Pilar Chías Navarro

Abstract Cultural Heritage is increasingly appreciated in our country. Nevertheless, this concept is still far from being considered in its real extent. While artworks, architecture, and archaeology were traditionally considered as essential vestiges of our past, landscapes and regions were ignored. As a consequence, their capacity to evoke old uses and customs was underestimated, as well as their power to create a strong sense of local identity. A deep knowledge of the history of the territory and the landscape is thus needed as a previous step before undertaking any regional planning or infrastructure. Drawing and mapping become essential tools to perform such a conceptual change.

Keywords Cartograpy · Landscape drawing · Cultural heritage

1 Introduction

Spain is fully aware of the value of its outstanding cultural heritage, as considered in the full sense that includes artworks and architecture, but also territory and landscape.

The underestimation of the territorial scale was evident in traditional researches into landscapes, that used to ignore the importance of old infrastructures. This omission is quite paradoxical when considering that minuscule fragments of Roman household items are carefully studied and classified, while big dams, long pipelines, or important bridges of the same epoch are still misregarded.

Industrial archaeology incorporated lately into the concept of heritage, despite its importance in daily life and socioeconomic development. Mills, saltworks, or mines, frequently built since the beginning of the Christian era, become essential elements to understand the evolution of a territory and a landscape. Similarly, an adequate knowledge and documentation of many other elements that historically

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served to structure the territory is needed, such as the royal roads with their related constructions—country inns, posthouses, or mountain passes—, but also the canals and the traditional irrigation systems, the railways, etc. All of them were only recently considered as essential parts of the cultural legacy.

An example of the lack of consciousness about the value of these constructions and devices was displayed by the Spanish Academy of History in 1918, when it faintly protested about the proposal of demolition of the Roman aqueduct in Sevilla that was agreed by the Provincial Commission of Monuments and the municipal council. Arguments presented involved an aesthetical point of view, reasoning that it was any artwork because "art was deserved to places where it could talk to the spirit and the eyes". Finally only "the length to be preserved should be defined by mutual consent", as the aqueduct was "vulgar, without artistic traces, or archaeological interest" (Fernández Casado [1972] 2008, 174–177).

Probably the strong functional character of all these constructions helped to foster this attitude, but their contribution to the development of communities was crucial, as they were the real signs of the spirit of progress that encouraged their builders, always at the avantgarde of new techniques and materials.

Unfortunately, sloth and unconcern led this essential heritage to ruin, or even to bad interventions that were built up with diverse results. As a consequence, it is urgent its location, documentation, description, and contextualization, as previous steps before planning or undertaking any action. Cartography and drawing play an outstanding role in this process.

As a case study we propose the Mountain of Guadarrama and its historical passes, that are documented from the Roman era onwards. Since the Middle Ages these mountain passes communicated uninterruptedly Segovia and Toledo, and lately the Royal Sites and Woods of La Granja, Valsaín and Riofrío –located in the northern slope of the Sierra—, with El Escorial, El Pardo and Madrid—in the southern side.

2 The Study of the Territory and the Landscape: A Methodological Approach

The geographical phenomena which left their traces on the surface of the Earth due to natural or human activities, conformed along the centuries a structured set of forms and signs that must be read and understood, and are embodied in the concept of 'territory'.

On the other hand, 'landscape' is the territory as it is perceived and experienced by an observer who establishes some aesthetic, scientific, emotional, moral, and cultural relationships with it. Accordingly, landscapes are unique and not transferable to each person.

Both concepts are subtle distinguishable, but compose a particular geographical area, a *locus* that can be approached from the point of view of the objective territory

—that is scientifically describable and analysable–, and from the perspective of the landscape—deep-rooted, full of subjectivities and cultural meanings. The integration of both approaches is a main target of our proposed methodology that will never renounce rigour.

As a consequence, the study of the construction of the territory (Chias and Abad 2012), or according to Ortega Cantero (2004, 44) "the historical geography of landscape", needs to manage various types of graphic, cartographic, and written sources, both ancient and contemporary. Maps in particular provide essential information about the geographic elements existing in a historical moment or period. On the other hand, landscape drawings and photographs become subjective visions, partially influenced by schools of thought. Finally, written documents—including travel diaries, literature, and other historic papers—are frequently important in order to read and understand properly the graphic ones.

Once the various elements are found and checked on the different sources, they are georeferenced. Their location and state are also verified along the phase of field work. This stage of the research is particularly interesting because it comprises the production of drawings and surveyings, as well as an exhaustive description and illustrated report.

All these datasets are integrated into relational multiformat databases that we designed by means of an open source software.

Simultaneously, the digital cartography scale 1:25,000 is produced. It is based on the updated edition of the MTN series, and structured as layers corresponding to the different types of geographic elements. Many other features are drawn on the map, as they are found and located on the various sources, and during the following field work campaigns.

On a later phase databases are linked to the map in order to implement a geographic information system (GIS). Among the outputs of the GIS the thematic map series representing the successive historic periods mut be highlighted, and when they are considered as an ensemble, they permit to reconstruct in an objective manner the successive phases in the construction of the territory and the landscape.

3 Mapping the Territories Around the Mountains of Guadarrama

The famous statement coined by Alfred Korzybsky that "the map is not the territory", summarizes the quality of the map of being an abstraction derived of the territorial reality. It is then an artifice that permits the cartographer to select, simplify and represent at a reduced scale those elements of the geographic reality worth to be drawn. Maps benefit themselves of a cartographic tradition, of its methods and techniques, but they are also the result of historical events and of cultural contexts.

Before the use of the modern map symbology and conventions were agreed by the Western Countries –what happened as a result of Napoleon's campaigns and the creation of the Bureau Topographique de l'Armée in 1802—, cartography used various iconic symbols lacking of accuracy. This problem proved to be irrelevant in large scale maps surveyed with the traditional topographic instruments, as they were enough accurate and reliable to their purposes (Chías and Abad 2014). Similarly, local maps and plans of buildings and civil works were drawn in detail, as they focused on strategical points and landmarks, as mountain passes or royal estates (Chías 2013, 2014).

However, the lack of accuracy could be important in small scale maps. In this sense, reports by Bory de Saint-Vincent revealed the ambiguity of the maps drawn by the famous cartographer Tomás López (Manzano, Fernández and San Antonio 2013), that were considered until then the most complete and trustable about the Iberian Peninsula. Lopez produced his maps by means of compilation without any field work, resulting useless for military campaigns. "It is specially to separate the slopes towards the Mediterranean Sea from those draining to the Ocean, that multiple crests, summits, anastomoses, spurs, and all what a burin can imagine were drawn in black to offer a rough alpine physiognomy. However, wide plains [...] extend exactly where these mointains were supposed to be. Confused about such information, the officer estimates the position of obstacles or defence points he will never meet. Naturalist also dreams of steeps propitious to his researches, that will transform into an arid horizontal area" (Bory De Sain-Vincent 1823, 7) (Figs. 1 and 2).

The lack of a trustable cartography of some strategic points as the mountain passes along the mountains of the Central System in general, and along the Guadarrama in particular, fostered the production of an important set of maps during the Peninsular War. This production extended to the 19th century as a result of the Spanish-French campaigns that took place within the agreements reached from 1823 until 1832. Previous experiences of the French officers in the Peninsula, together with the increasing demand of travel books on Spain, involved the production of an important set of manuscript maps. This set is still custodied in the Archivo Cartográfico y de Estudios Geográficos del Centro Geográfico del Ejército in Madrid, and also in the Service Historique de la Défense in Vincennes (Chías and Abad 2016).

These works set the basis of the modern cartography of Spain, that was soon after initiated by the famous Spanish cartographer Francisco Coello in his *Atlas de*

Fig. 1 Juan de Villanueva, 1788. *Plan que demuestra el trozo de camino que se proyecta ejecutar desde el Real Sitio de San Lorenzo hasta unirse con el camino antiguo que desde el mismo Sitio conduce a El Campillo y Guadarrama*. Archivo del Palacio Real, Patrimonio Nacional, Madrid

Fig. 2 Tomás López, 1786. *Cercanías de Madrid*. Real Academia de la Historia, Madrid

España y sus posesiones de Ultramar. Coello's cartography began in 1844 to complement the *Diccionario* by Pascual Madoz, and was almost immediately followed by the works led by the Commissions of the Map of Spain (Comisiones del Mapa de España) depending on the Junta de Estadística. These commissions completed the geodetic surveying and closed the national geodetic network, and started as well the production of the outstanding series of the Topographic Map of Spain (Urteaga and Camarero 2014; Arístegui et al. 2015) (Figs. 3 and 4).

Fig. 3 Depósito de la Guerra [1809], *Plano de los alrededores de Madrid*. Archivo Cartográfico y de Estudios Geográficos del Centro Geográfico del Ejército, Ministerio de Defensa, Madrid

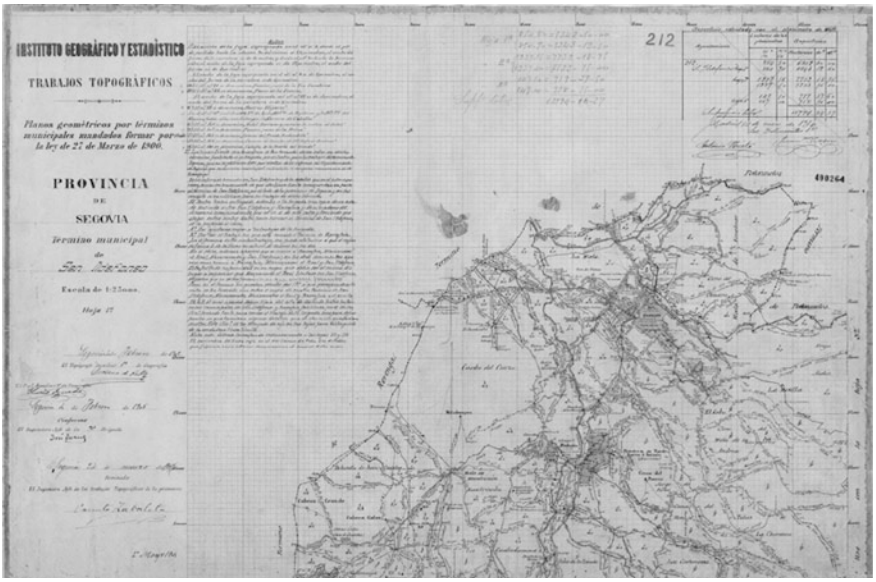

Fig. 4 Instituto Geográfico y Estadístico, 1905. *Planos geométricos por términos municipales mandados formar por la ley de 27 de Marzo de 1900. Provincia de Segovia. Término municipal de San Ildefonso*. Instituto Geográfico Nacional, Madrid

4 Drawing the Landscapes of Guadarrama

Since the end of the 18th century von Humboldt ([1845–1862] 1874–1875, I: 7–71) modernized some of the concepts related to the knowledge of the territory, through the adoption of its cultural aspect—its associated set of values and meanings—and the attribution of its capability to express both the structure and the internal order of the geographic reality perceived through vision (Fig. 5).

The new aesthetic atmosphere supposed a true renewal of the ways of thinking, of perceiving, and feeling. This new attitude could be summarized "who looks at a landscape and understands its language, can read an accumulation of geological forces, climate changes, passes across steppes and woods, rivers or lakes, hunters, farmers, devastating armies, pacient reconstructions, forest fires, gardens, economies and societies that were gone or still persist or still are to come" (Martínez de Pisón 2010).

It was then obvious the need of learning the way to see and how to read, concerning also those integrated elements that were not so evident. It became also essential to look for new ways to describe the landscape, both graphic and written—not to mention other kind of expressions as music.

Humboldt himself devoted a chapter of his book *Kosmos* ([1845–1862] 1874–1875, I: 72–89) to "the influence of landscape drawing in the study of Nature", where he stressed the importance of representing the existing links between men, territory and landscape, "some of these misterious analogies and moral harmonies that link man to the external world" ([1845–1862] 1874–1875, II: 4).

Romanticism brought up the modern tradition of modern landscape painting, and thus the images included in traveller's books, in reports of expeditions and in literature, turned to be their essential complement, as well as scientific evidences and demonstrations of the writings (Duviols 1989, XV).

Fig. 5 José de Hermosilla y Sandoval, 1757. *Vista del Monasterio de El Escorial*. Biblioteca Nacional de España, Madrid

As we mentioned above, the Peninsular War strongly contributed to raise the interest on Spain. And the same way it fostered the cartographic production, many travel books on Spain were written by foreign authors, mainly French and British, as Borrow, Ford, Merimée, George Sand, Gautier, Quinet, Dumas or Hugo. They created a new image of Spain, of its ways of life, human types, customs, and social structures. They were sometimes affected by clichés, but surprisingly their descriptions of the landscapes were less influenced by commonplaces (Alberich 1987, 21–44).

The crossing of the Guadarrama Mountains as described by Gautier (1845) is among the most significant examples of the Romantic visions of Spain: "Mountains rised higher and higher; as soon as we crossed one of them, a higher one emerged, previously hidden to our eyes; mules were not enough and oxen were needed, what favoured that we got off and ascended the mountain on foot. I was drunk with such a pure vivid air; I felt so agile, so happy, so filled with enthusiasm, that I cried and jumped as a kid; I desired to dive into such charming precipices, so blue, vaporous and velvety; I would like to be swept away by every waterfall, to put my feet in each spring, to pick up a sheet of every pine tree, to roll on the sparkling snow, to blend myself with Nature and melt as an atom in such immensity. Under the sunbeams, the dazzling high summits shone and glittered as the sequins on the skirt of a dancer; other peaks were covered by clouds and blended with the sky in insensitive gradations, as there is nothing more similar to a mountain than a cloud. There is no artwork that can express such undulations, scarps, shades and forms: neither a paintbrush nor a pen."

The contributions by the Spanish writers were also really interesting. Enrique Gil y Carrasco "was the first one to watch a landscape without using literary topics, to capture it within his soul, and to describe it so faithfully as his art could do" (Picoche 1978, 193); the works by Rosalía de Castro showed a deep feeling of the landscapes of Galicia, and Gustavo Adolfo Bécquer found in landscape a vivid stimulus to his imagination (Ortega Cantero 2004, 38) (Fig. 6).

These authors coexisted with more realistic perspectives at the end of the 19th century, as those of Jose María de Pereda, Emilia Pardo, Vicente Blasco Ibáñez and Jacint Verdaguer. An approach that showed its preference for description and its detachment from sentimental positions. It could be considered as a literary parallel to the tendencies in painting led by Corot and the École de Barbizon.

The integrated perspective was due to Francisco Giner de los Ríos and the liberal ideology of the Institución Libre de Enseñanza. Not forgetting the subjective cultural approach, they tried to meet both perspectives, supported by "the mobility of the look" (Berdolulay and Saule-Sorbé 1998), and based on the direct experience of landscape. This attitude changed the way of looking at the Country, helped to valuate its past and its present, and started a process of creation of a national identity (Ortega Cantero 2001).

According to Azorín (1916), "the aim of the Institución Libre—what means, the spirit of Giner—, has defined the group of writers of 1898; this spirit has evoked the love for nature, and consequently, for landscape and for Spanish matters, Castilian

Fig. 6 Fernando Brambila, 1821. *Vista de San Ildefonso desde el camposanto*. Patrimonio Nacional, Madrid

matters, love that has renewed our painting (Beruete, Zuloaga, etc.); this same spirit has provoked to turn the eyes in the direction of the traditional literary values, to revive memories of old poets, to reprint old editions of the classics as never before, and to create a new school of philologists and critics imbued with a brand new spirit."

Giner de los Ríos ([1886] 1915) wrote a lot about Guadarrama, stating that "granite, due to its composition and internal structure, shows a certain consistence, not only in quantity but in direction, to the atmospheric agents; as a consequence, it can not be destroyed but in way that is the origin of certain form. Wherever it arises, water rounds it off, producing in the smallest pieces such rough surfaces covered by lichens, that interrupt the continuity of the topsoil; and in the biggest stones create the typical forms of the 'piedras caballeras', enormous monolyths that oscillate sometimes as many other natural megalithic monuments do; until the effects of solar radiation, that heat and dilate them all day long, contract them by night, and cut them deeply into thousand cracks where ice swells making them break out, spreading enormous splinters, that piled up, conform the sharp serrated peaks of our mountain; their sawlike edge is particularly visible where the two types of granite meet: one of them more resistant, the other more breakable and fragile […] On the mountain […] all is matt and unfriendly […] Down in the wide valley, light is more uniform, shadows are less accentuated, shades are richer and brighter."(Figs. 7 and 8).

The ideology of the Institución Libre de Enseñanza, its didactic practice based on trips and direct experience of landscape influenced famous painters as Aureliano de Beruete and Jaime Morera, whose pictures reflected the reality of Guadarrama both perceived and objective, as a morfologic sign of the natural evolution and the footprints of man in such a wild country.

Fig. 7 Jaime Morera, 1891–1897. *Guadarrama*. Museu d'Art Jaume Morera, Lérida

Fig. 8 Aureliano de Beruete, 1911. *Vista de la Sierra de Guadarrama desde El Plantío*. Museo Carmen Thyssen, Málaga

5 Conclusions

Thanks to the fieldwork and to the ancient documents located in the main archives, it is still possible to recover lots of elements that conform the history of the territory and the landscape. Other sources as literature and art help to preserve our memory and identity.

Our methodology can be worldwide applied to reconstruct the successive historical epoch that conformed our territories and landscapes. As Bruno Zevi stated in the title of his famous book, we must "learn to look at landscapes". And according to Muñoz Molina (2016), "there is a plastic beauty that stresses and highlights the world of sounds […] Not far from there, when the visual is very much imposed, the ear gets distracted and deafened, as if the brain could not process simultaneously such an amount of sensorial novelties. If noise impedes a better vision, the visual agitation obstructs the full listening."

To summarize, we show our interest and ability as architects to recover and document the built heritage at the architectural and urban scales, but the forgotten heritage that composes the territory and the landscape must also play an essential role in our priorities.

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Pilar Chías Navarro Doctor in Architecture, Full Professor and Director of the School of Architecture in the University of Alcalá, is a specialist in the documentation and diffusion of the Cultural Heritage, and in the History of Cartography, the ancient civil works, and the construction of the territory and the landscape. She is chair person in numerous national and international congresses, and has published several awarded books and articles related to Cultural Heritage, among which the following stand out: 'A GIS in Cultural Heritage based upon multiformat databases and hypermedial personalized queries'; 'A GIS in Ancient Cartography: A New Methodology for the On-Line Accessibility to the Cartographic Digital Libraries'; 'Local Maps in Civil Disputes: Documents in the Chancelleries of Valladolid (Spain) and Nueva España (Mexico), 15th–18th centuries'; 'More than the Usual Searches: A GIS based Digital Library of the Spanish Ancient Cartography'; 'Precedents of the 19th century Cartography of the Coasts of Florida, Mississippi, Alabama, Louisiana and Texas: Spanish, English and French Maps and Charts, 1500–1800'; 'Spatial Data Infrastructures and Spanish Cultural Heritage: the INSPIRE Framework applied to the Monastery of El Escorial', and 'The Peninsular War 1808–1814: Unpublished French and Spanish Cartography of the Guadarrama Pass and El Escorial'. She is member of Ibercarto, and of the Task Group "Patrimonio Cartográfico de las IDEEs" (Infraestructuras de Datos Espaciales de España) of the Consejo Superior Geográfico and the International Cartographic Association (ICC). She currently directs the Task Group "Open Source in use for the Cultural Heritage communication process" del CIPA—ICOMOS), and has supervised fourteen Ph.D. research works.

Part II
Design and Education

New Procedure for Teaching if the Manual Drawing in the First Year of the Degree in Studies of Architecture in the ETSAB

Joaquim Lloveras i Montserrat and Judit Taberna Torres

Abstract We have been introducing during last years a new procedure using photography as a tool to improve the traditional teaching methods of manual design. We used it as a support for drawing the plans and as a background for the perspectives. Using two different focal lengths our students get two spaces; one introduces us into the space we really feel and the other represent the space we are able to remember. The student has to make a final presentation on a single support, which summarizes his work. It has to include his sketches and the photographic support used by him.

Keywords Drawing · Photography · Architecture

1 Introduction: Transversally in Hand Drawing

Each year we have found many difficulties to be able to achieve that the students were overcoming *Drawing's I* subject and managing to reach the proposed aims. For this reason a group of teachers, worried by the results of the students, we start investigating different tools in order that the student could acquire the necessary knowledge demanded in the academic program: understanding space, and doing sketches of the same one, using different systems of graphical representation.

A few years ago only the paper and the pencil was used for being able to develop the exercises. Seeing the difficulties of the students, we introduced a new procedure to help them to relate their drawings to the observed reality: the photographic one. Across photography we can, once observed a space, capture an image of the same

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one with which later we will work: drawing on the same one, or as help for the comprehension of his geometric representation.

In this communication, we expose the way this new procedure has been introduced, the photographic one, in the teaching of the manual drawing of the first year of the degree in the ETSAB; as well as those educational transverse aspects that have allowed his correct implementation and the dynamization of the educational process. The evolution of this new procedure in the teaching of the subject of *Dibuix I* up to the course 2013–14, is explained in the article published in the XII Jornadas de Redes de Investigación en Docencia Universitaria de Alicante (Lloveras and Taberna 2014).

During the course 2014–15 the new procedure has been put into practice in its entirety in the education of manual drawing in the studies of the degree of architecture, in this communication we focus not only in the photographic procedure, but in all those educational transverse aspects (that can treat from other disciplines) that they allow to show the reason of what has been done and, at the same time, for the ones who should want to put into practice, the way forward.

Is for it that, besides the specific of the procedure of the architectural photography, it is necessary to add and value three more educational complements, of transversal tour to the exclusive one of the photographic procedure, to the effect that, though they are autonomous, for his major achievement they interlace punctually his knowledge.

It is the case of the knowledge about visual fields, about interventions in real spaces, about incorporation/exclusion of elements, because without these educational complements one had not managed to introduce fully the photographic procedure. These complements also have to be considered to be innovators as it is, since they were not specifically exposed in the educational contents of the subject of the previous Plans of Study of the ETSAB.

The communication that we are developing is divided in two parts. In the first one we analyse the four most relevant changes introduced in the new teaching of the manual drawing, mentioned previously:

– Relation between drawing and architectural photography.
– The Good Vision and the Great Depth: the visual field.
– Interventions in real spaces: subtraction or addition. Sculptures.
– TK Model.

We complete this communication with the current situation of *Dibuix I* subject inside the Study Plan and with some examples of exercises realized by students (number of theoretical and practical classes, number of students for group for teacher, schedules, etc.).

2 Relation Between Drawing and Architectural Photography

Drawing and architectural photography use the light as a basic element to perceive the space, either as a real materialization or either as a two-dimensional image. When we go with the students to draw, we ask them to go all over the place, in all the directions, they have to analyse the space, to use all the senses to see the architectural elements, in order that they could be capable to draw these spaces in a paper and to photography them with their camera. Pallasmaa (2012) sketch as: “The act of drawing that produces three different games of images: the drawing that appears in the paper, the visual image registered in the cerebral memory and a muscular memory of the act of drawing itself”. This game of different graphical representations helps the students to understand the architectural space.

In fact, we understand photography as a tool to improve the manual drawing, because it helps us to be able to look, to analyse the real space where we are placed; the space of our work.

As Calvino explains to us (2002): “There were many possible photographs of Bice and many Bice impossible to photograph, but he was looking for the unique photography, which can contain both”. We do not ask students to look for a rapid photography, removed from a previous analysis of the photographed, but of promoting a reflexive, pondered photography, which it helps us to capture, and then remember, the most important aspects of the analysed space that the students are working on. Francesc Català-Roca, says to us how he understands the architectural photography and the process itself of reflection and analysis, “You have to visit the site, then think about it and eventually look back and find the angle or vision that sums and expresses the most eloquent possible way” (Roman 1998).

The concept of photography introduced in the teaching of manual drawing is not just photography as a ool, otherwise is the necessary support to the sketches realized by the students. We draw using the orthographic, axonometric and conical projection to represent the objects and the spaces, and we mixt all theses drawings with the photographic images. It is evident that a photographic image helps us to do sketches, for example, of an element of furniture; if the student uses the images, he can understand the strong abstraction that is leading him to expressing it, for example in the orthographic projection.

We think that as nowadays the architect, together with his pencil, also takes his camera; we should incorporate it forcing his use as a complement of the classic educational procedures, the sketches, which serve us to analyse the elements of the architectural constructed spaces. To materialize the exercises, they work with different technics such as collage or photoplastic, the name used in the Bauhaus School. As Moholy-Nagy ([1925] 2005) says: “The photoplastic is based on the interpretation and the merger of related elements that in the daily life are not always perceived as such, and neither they are during the visual apprehension of simultaneous events”. This technology of graphical representation allows us to create unreal images but of great academic content, because the students can explain in a single sheet an architectural space from the merger between sketches and photographies.

The photographies are done principally with the use of reflex cameras, saving all the results in files such as jpg or similar. We give some technical minimal knowledge on quality of image, ISO sensibility, focal overture, etc. With regard to the focal distance, there are in use always two focal predetermined, comparable to the areas that we force the students to draw in their sketches. One introduces us in the space in which we really feel; the other one includes the whole area of the space that we are capable of remembering. We will see hereinafter his justification.

3 The Good Vision and the Great Depth; Two Predetermined Distances to Draw and to Photograph

We can say that the photographic procedure has been implanted in the teaching of the manual drawing. Now then, given his complexity of implantation and the aspects that have been arising, make us see that, to explain clearly this long period of implantation we have to go on parts. The first thing that has to be said is that it is not possible to forget that his introduction is realized in parallel to the theoretical investigation on the perception of Lloveras i Montserrat (1997).

With this investigation, it is possible to explain one of his principal achievements, which is the implantation of two ways of drawing/photographing: from the Good Vision and/or from the Great Depth. We are going to explain it more detailed.

One of the most committed aspects has been to explain, and to justify, to the student the relation that exists between his vision, the Person and the photography. As result, at present it is made clear to the student, in a simple way, that the vision is the aptitude to see, of perceiving with the eyes; it is to say, the light, direct or reflected, that, in every instant, it comes to our eyes of the space to which we direct our look. The studies on the way in which we perceive this light are included in what we name the visual fields, which analyse and delimit the different areas of our vision.

It does not even hundred years that Traquair, which was a pioneer of the studies of the visual field, defined our vision "as an island of vision or hill of vision surrounded by a sea of blindness" (Traquair 1927). This *Island of vision* corresponds with a sudden change of perception of the space for us observed. In the interior of the island we can see more or less fine, but the exterior appears to us very deformed. With practical experiences in the classroom, or in any other space, the student manages to notice the existence of this Island of vision.

So for this reason the student understands why the area chosen for his sketches justifies these limitations of the Island of Traquair's vision: in order that what we see of the observed space is the part that we see well, without big deformations. To these limits we name them of the *Good Vision*. The horizontal limits correspond with the exterior limit of our Blind Points; they are easy to find and to draw them into the paper support. These limits also were used for the photographic images;

that will correspond, depending to the reflex camera, to a focal distance around 30 mm. Also there is exposed to the student that, besides these limits of the *Good Vision*, there are others that arise when we want to capture, not only the space that we perceive well, otherwise everything what we remember of the analysed space. The above mentioned limits arise from the studies of the *mental images* of Finke (1989). To these limits we name them *Great Depth* and they contain in its interior those of the *Good Vision*. If we move it to the field of the photography, and depending to the reflex camera, the focal distance will be around 20 mm. These two basic aspects, the *Good Vision* and the *Great Depth*, they are include in the different publications of the UPC that the student can consult in UPCommons, the *Portal of knowledge opened of the UPC* (Lloveras Montserrat 1997, 2009, 2012, Lloveras and Taberna 2012).

Throughout these years of implantation of the photographic procedure in the ETSAB, diverse public Experiences have been realized in the School, related by the topic. In June 2007, the first *Experience* was done in the ETSAB. In the course 2008/2009 there was done the first exhibition of the *Experience of the Good Vision*, which a Great Ellipse of TK proportion was showed, this experience was published in the missing *arquitecturarevista* review of UNISINOS's Brazilian University. In November 2012, a new exhibition/experience was realized, in collaboration with the Foundation Juan Miró, in the Hall of the ETSAB. The Great Ellipse TK was showed again and we focus very much in the *Great Depth* concept (Lloveras and Taberna 2012).

4 Interventions in Real Spaces: Subtraction or Addition. Sculptures

Another innovation that we have been doing throughout these long years in the teaching of the manual drawing has been the introduction of sculptural elements in the real analysed space. We work always in a real space in which we introduce sculptural elements of strong architectural component (Ate Huts of Oteiza, Matter of Time of Richard Serra…). These sculptures give the scale of the space and force the student to understand, and to express it graphically. The student has to relate the sculpture with the already existing space, with the surrounding, and with the persons who live through it and that cross it. The use of the photography serves us to introduce these sculptures in the drawn space or to use it as a background when we outline the tours for its interior (Figs. 1 and 2).

As we have been introducing the sculptural mentioned elements, we have been also removing, or changing, elements and/or parts of the real space analysing parts of the same one. And this is for two reasons: because we understand that for the student it is easier to think that it is not a *finished* drawing what we asked him to do, but a series of sketches that explain more than concretize; and because for this reason the student approaches more to the drawing of idea, of project. As Berger (2011) says: "There are drawings that are studies, forms of investigation and others that are sketches for

Fig. 1 Examples of the exercise we-are-not-so-different, TK model

Fig. 2 Example of the exercise photographing the section

projects of masterpieces. Many types of drawing exist…". We encourage students to draw as a new form of investigation, as an analysis and process of reflection of the real architectural spaces. The space that the students have to study exceeds always the real one, is bigger than the real one and then turns into a place where everything is possible, into where the students can decide, with the virtually of the lines of their drawings, which belongs definitively to the space and what they want to change or add. As Pallasmaa (2006) says: “architectural space is lived space rather than physical space, and lived space always transcends geometry and measurability”.

5 TK Model

It is important that the student understands that the Person always is at the back of the architecture. That it is logical, so, to know his measures, beginning for theirs, those of the own student, because all this measures will influence the student ideas and designs of the spaces. It is for it that, as a result of the investigation carried out in the TK Theory of Visual Proportions, in the course 2012/2013 created a new exercise based on the model of the Person that appears in the website of the Department: http://ega1.upc.edu/recer-ca-en/research-projects/we-are-not-so. The students, in groups, photograph each other between them, and are compared with the model TK facilitated.

The final result, during these three years, has been fully satisfactory.

In this way the students understand that the teaching of manual drawing is transverse with other knowledge, it is not just drawing, otherwise is searching for his justifications in the Person, in him; as they should have understood that the Good Vision and the Great Depth, justify their photographies and sketches. For this reason, the student is forced to design a model of the Person that he will include it in all his drawings, to give the scale of them and to fill the space drawn with the Person that always uses it.

6 Educational Circumstances in the Current Study Plan

The subject of *Dibuix I* is the one that contains wholly the Manual Drawing of previous plans. It is given in the Degree in Studies of Architecture of the ETSAB. It has 6 credits ECTS. Up to the previous course the classes have been four-month period and, from the new course 2015/2016, it will be given in an annual way. The course load is distributed in Groups from 65 to 80 students, with a ratio of three teachers, that is to say, corresponding approximately 25 students for every teacher. The number of repeaters changes between a third and a fourth part of the total. The teaching is distributed in 14 h of Theory and the rest, approximately 56, in practices. The exercises in which the photographic procedure is introduced are all those who correspond with the basic theoretical classes, the ones related with objects and/or small spaces, in an approximate number of twelve exercises, and four of them correspond to the exercises of synthesis of the second part of the course, where the students work with medium and/or big spaces. It is expected a time of execution of 6 h for the first ones and of 10 h for the second ones. Some exercises are realized in groups of 3 or 4 students.

The course consists of two parts. In the first one there is given the theory corresponding to the contents recognized in the Plan of the Study: the drawing of the space like a system of representation for projection, the sketch as data gathering and synthesis, the ergonomics and his relation with the architecture, simplified sketches for the control of visual tours interior/exteriors, details, collage and photomontage. As for the exercises of this first part, we have continued the same method used for years: it splits initially of the object that the student can see, can take, can give him the return; hereinafter a step is advanced towards the analysis of small spaces in which the student already cannot take it, but he is, together with objects, inside him. In the second part there is given the theory focused on the preparation and execution of the analyses of the architectural complex spaces where the students have to work. The presentation of the exercises is done in two levels: by means of manual *classic* sketches, which are continued, evidently, realizing and they appear in the Folder, or Note-pad, which to such an end the student arranges. In parallel, using Gimp, Photoshop or any other program of graphical composition, the student does, of each of the realized exercises, a *virtual delivery* across the Moodle platform of the UPC, Atenea, in which he must select part of the realized sketches and attaching to one, or several photographic images of the topic in question and/or using them for the background of the final presentation of their work. It is in this virtual delivery, where the student has to strain in synthesizing in an only support A3 what he wants to express of the object or of the analysed space. A copy of the result is attached also to the Folder of the student.

The introduction of the photographic procedure has been gradual, beginning principally in the execution of the exercises of the first part of the course, that one who, since we have commented, collect the contents of the subject and where the exercises are realized analysing objects and/or small spaces. In the second part of the course, where we analyse architectural complex spaces, his introduction has been later, very pondered.

In this part the student realizes, for each of every four exercises, a final presentation, in an unique support, that summarizes every work. In this one it includes part of the sketches and of the photographic support used by him.

7 Conclusion

The educational aim is to help the student to create a manual unreal image (sum of partial images), in order to improve his comprehension of the space, and that can be used by him to be able to express better his architectural ideas, and to be able to think of designing his own spaces using the photography as a basis for his interventions.

It can be said that nowadays we do not understand the teaching of the manual drawing without his improvement with the photography. A limited group of teachers have been introducing the photography, step by step, throughout seven years. Today, when its application in the last course has been already from its beginning, we can say that really it improves the teaching and, we think, it must be added definitively to the contents of the subject (Figs. 3, 4, 5, 6, 7, 8 and 9).

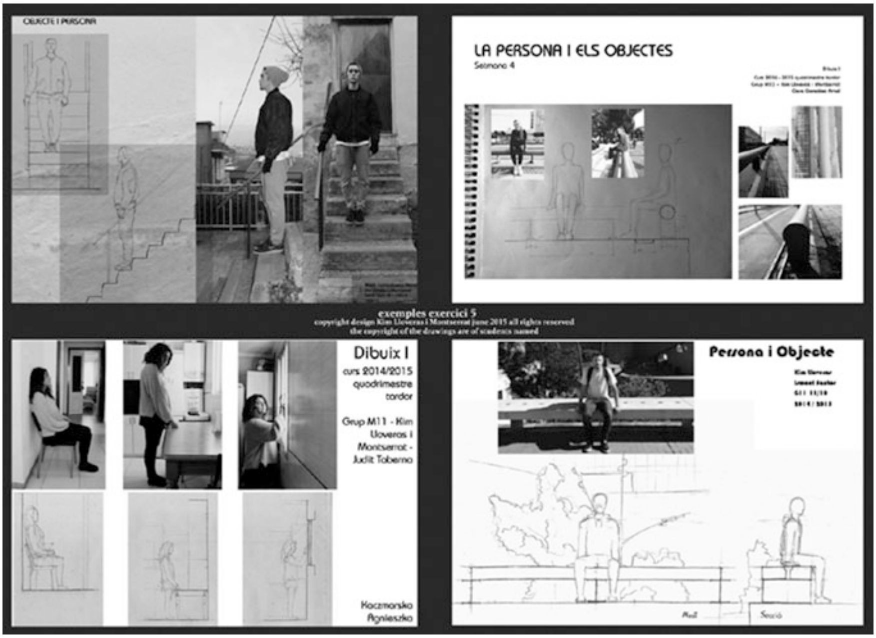

Fig. 3 Examples of the exercise people and objects. As a support for data

Fig. 4 Examples of the exercise drawing the depth. This is one of the oldest exercises in our hand drawing teaching

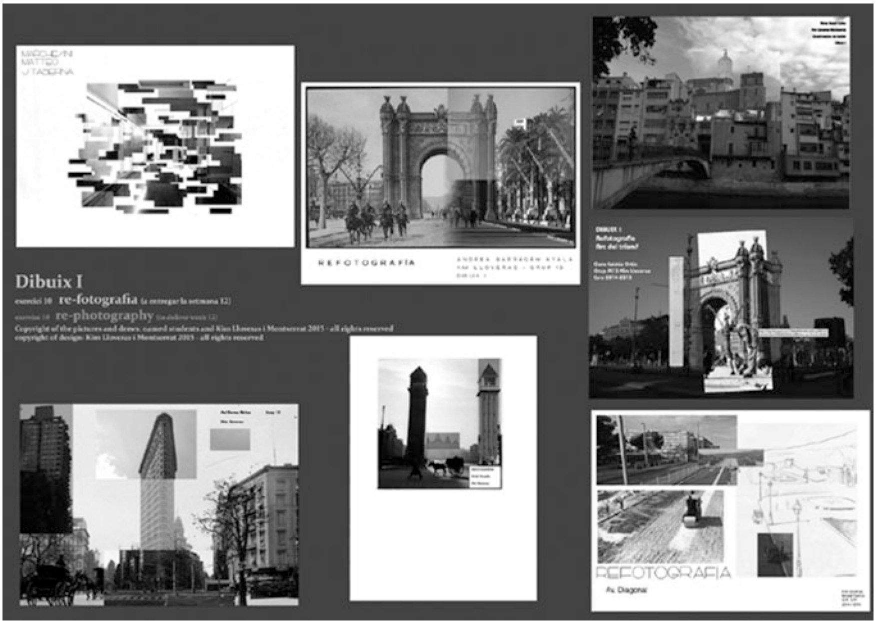

Fig. 5 Examples of the exercise of old photography, current photography and drawing

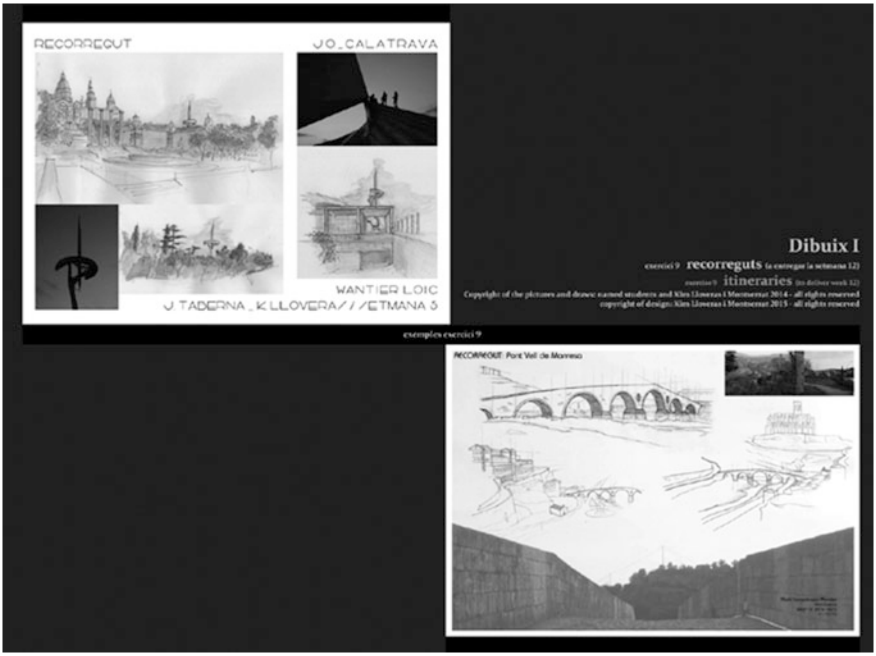

Fig. 6 Examples of walk through the city: three times

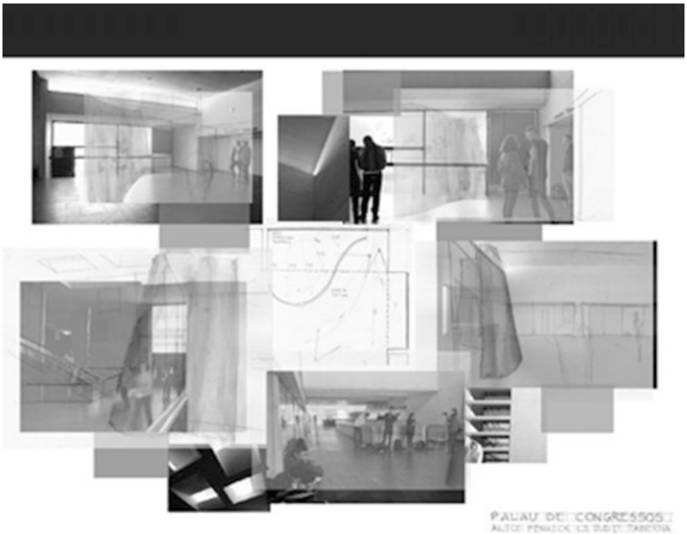

Fig. 7 Examples of the final presentation work of the exercises of the second part of the year

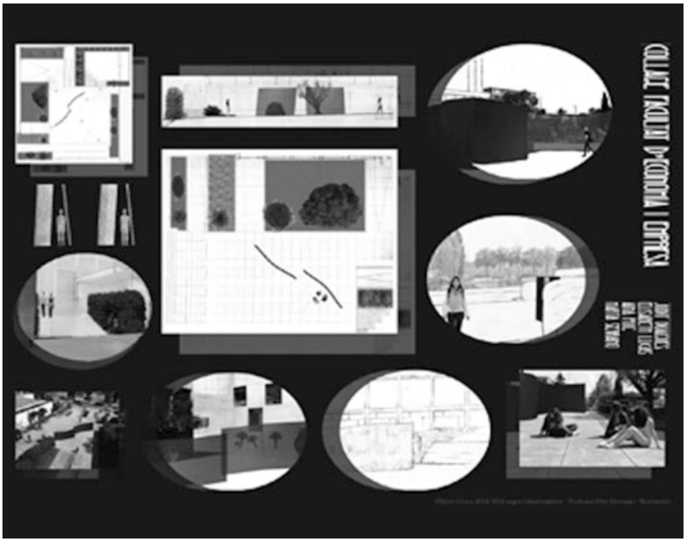

Fig. 8 Examples of the final presentation work of the exercises of the second part of the year

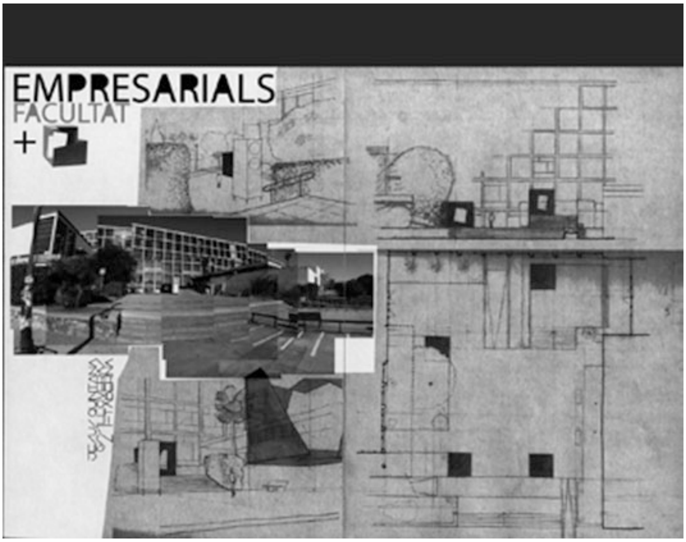

Fig. 9 Examples of the final presentation work of the exercises of the second part of the year

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Summer Workshops on Graphic Expression. Study Case

Sonia Izquierdo Esteban

Abstract Some students entering university have little contact with architectural studies and their training in drawing in some cases is scarce. Besides, the decrease of instructional time on graphic subjects favors that these summer workshops on Architectural Graphic Expression may become an introduction and preparation for the degree of Architecture through drawing. Two summer workshops that took place during the summer of 2015 at San Pablo CEU University are analyzed. New technologies facilitated the exchange of results and disseminated the results of an experience that, despite its brevity in time, was intense and lasting for students.

Keywords Pre-university course · Teaching innovation · Graphic expression

1 Introduction

Are summer workshops on Architectural Graphic Expression a good tool for students to know their vocation and receive a practical introduction to the Architecture degree?

Some students who currently apply for the Architecture degree have had little contact with the studies and the architectural profession. Many of them have no clear vocation or want to confirm it, because they have not received sufficient guidance in high school. These workshops offer them the opportunity to have a precise notion of the content and methodology used in university degrees. It is a more direct way of knowing about the degrees than the one obtained from texts or comments from friends or family.

Some pre-university students training in drawing is scarce. On the other hand, the decrease of graphic subject class hours favors that these summer workshops become on an introduction and preparation for first degree graphic courses. Workshops on Graphic Expression introduce architectural graphic disciplines to

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help them understand the beginnings of creative processes, starting from a different way of looking and from an expressive and abstract drawing which is able to catch a new experience for them.

They are also a way to take advantage from an academic point of the long holiday period, generally unproductive, to continue learning in a fun and different way from the one they are used to in high school or school. For students who have not completed their pre-university education, theses workshops may be a motivation to continue their studies.

2 State of the Art

There are summer terms to provide continuous training to American university students. Spanish summer courses are extensive although many of them are mainly theoretical. In recent years, open online courses (Massive Open Online Courses, MOOC) have appeared. They include team and interactive working, but they cannot be compared with a classroom workshop about learning how to draw. My personal experience, after studying one of them entitled. Innovative generation, how to be creative, five-week long and organized by the University of Texas, is that they fail to develop creativity as much as in a classroom course. These courses provide theoretical ideas and some short exercises to exercise creativity in hypothetical situations but there is no personal experience or a real practice, so they do not seem to me comparable with summer workshops.

San Pablo CEU University has a program of summer courses called Summer University, with a wide range of topics. Some of its courses take place in foreign universities, allowing students to travel, meet new colleagues or take in other countries. Within the Summer University program, the Institute of Technology held a workshop in Edinburgh in 2010 and another summer course entitled "Learning to draw" in 2011. Interesting pre-university courses about engineering degrees are also held on weekends. They are intended to introduce university degrees through practical experience.

3 Case Study

The workshops held at the Institute of Technology during the 2015 summer objectives were:

- Facilitate students to discover their interests, aptitudes and vocation.
- Visit, meet and draw the reality of an area of Madrid and use their drawings as a starting point for new creative processes.
- Develop a graphic experience from two to three dimensions in which divergent series of drawings sought open possibilities before reaching a final solution.

- Enhance the fun side, linked to creation, without conditions about grades or full agendas.
- Deepen their knowledge of graphic expression so that it would allow them to try and guess the enormous amount of possibilities from graphic tools available at their fingertips.
- Encourage active participation and communication among students about their experiences, while promoting reflection on their drawings and designs.

The two summer workshops that took place at the Institute of Technology of the San Pablo CEU University during the summer of 2015 were free and open to all high school and last ESO course students who were interested. There was no requirement for registration. The necessary graphic material was provided free of charge by our University.

The first workshop was entitled “Fundamentals of Design and Architecture” and was thirty-two hours long, spread over two weeks. Its character was introductory and allowed students to understand the differences between the degrees, especially about some technical areas exclusive of the Architecture degree.

The common thread to all the sessions was the Madrid-River area, a recent intervention and adequate area to be drawn during summer time. Many students had never been there. During one of the first sessions, the students visited the area and drew in situ with expressive technique, taking advantage of the good weather. In another session, students visited the National Museum of Decorative Arts in which they drew and received an introduction to Design and Museology. This experience was also new for them. After the visit, information on cultural activities held in the city of Madrid was handed-in and students were encouraged to visit other museums and exhibitions during their free time (Figs. 1 and 2).

Fig. 1 Session on Form Analysis. Drawing at Madrid-Río

Fig. 2 Session at the National Museum of Decorative Arts. Sketching

The second workshop on "Fundamentals of Drawing for Architecture and Design" was shorter, sixteen hours long. It focused on the different types of graphic expression used by architects and designers. The object of study and drawing culminated in one of the bridges that crosses the Manzanares river. It was drawn in two and three dimensions, by hand and by computer. During the last session, the whole group of students built a scale model of the bridge in the model workshop.

The first workshop was attended by twenty students aged between thirteen and nineteen from the Community of Madrid and other communities. The second workshop was attended by seventeen students with the same ages and backgrounds. A small percentage of them attended both courses. According to the teachers, the willingness and attitude of the students was very good, possibly due in part to the type of activities which managed to keep their attention and also due to the voluntary character of the workshops. All sessions were eminently practical. The teaching methodology was based on three ideas, encourage action more than inspiration or thinking, prioritize the process rather than the result and encourage a playful atmosphere rather than surveillance. These three ideas or legs were imaginary supports of the table of learning of these workshops. So the table would not bend, losing its horizontality, the teachers work was essential. Their task was to balance the three legs and achieve horizontality, so students could at the same time express themselves through drawing, experience and enjoying (Piaget 1972; Vygotsky [1986] 2003; Pestalozzi and Cabanas [1819] 2006).

Students, despite their youth and inexperience, had no difficulty in using specialized computer drawing and image processing programs. The workshops methodology helped students with less graphic experience to learn quickly from their peers drawings. According to the students who were going to be enrolled in

Architecture after the summer, the workshop was a big help. It allowed them to have a first contact with computer and drawing materials needed for the degree. They could prepare in advance the beginning of the degree by downloading, acquiring and practicing with the required software.

Without the obligation of fulfilling an agenda or evaluating the results, exchange and collaboration between students were fundamental for their learning. As it is explained in the objectives, play and reflection were encouraged at the same time. This festive atmosphere fostered relationships between students of the same age. The session on construction of experimental models from their drawings and the session on treatment of images taken by them during a visit to Madrid-Rio gave free rein to their creativity and imagination. At the beginning of each session some time was devoted to reflection on drawings from the previous session. Students talked about what they had liked most and the difficulties they have had (Figs. 3, 4 and 5).

Seventeen teachers participated from various subjects such as Architectural Drawing, Form Analysis, Descriptive Geometry, Computer Graphics and Visual Communication, Graphic Design, History of Art, Design, Architectural Graphics and Structural Design. The first sessions dealt with the subjects of the first courses of the degrees to advance later on with the subjects of the upper courses. Most open and gestural drawings were given priority and codified and more complex drawings were explained afterwards. The sessions were held by two teachers, the same way as it is carried out in the grades. Two teachers and a reduced number of students allowed a direct and friendly contact between teachers and students. The teacher student ratio in both workshops was of two students per teacher which facilitated good pedagogical results (Fig. 6).

During two sessions teamwork was held. The groups were randomly organized so that students did not know each other in advance and groups changed from one

Fig. 3 Session on construction of experimental models in three dimensions

Fig. 4 Session on Form Analysis. Expressive drawings about the Madrid-Río walkway

Fig. 5 Session on processing Madrid-Río images and drawings

session to another. At the first session, teams designed a system to hang panels for an exhibition; representatives of each group explained the advantages of their proposals and after the explanation the best solution was voted. The objective of this session was to encourage active participation from all students and practicing effective communication of design ideas to other classmates.

During the second session, after an introduction about the potential of the FabLab workshop, all students divided into small groups helped to build a scale

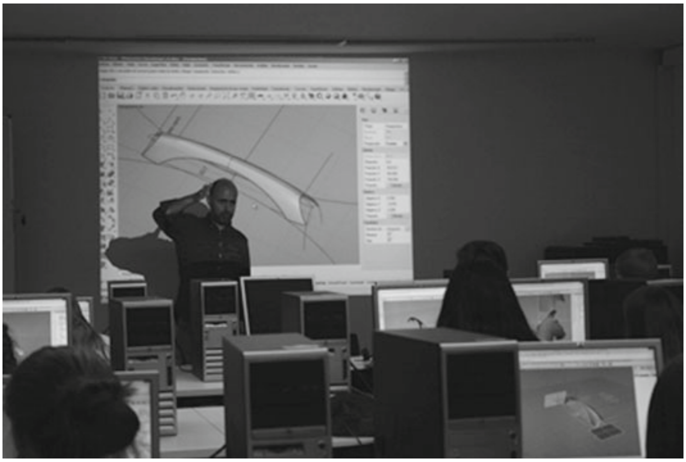

Fig. 6 Session on Descriptive Geometry. Drawing Madrid-Río walkway in three dimensions

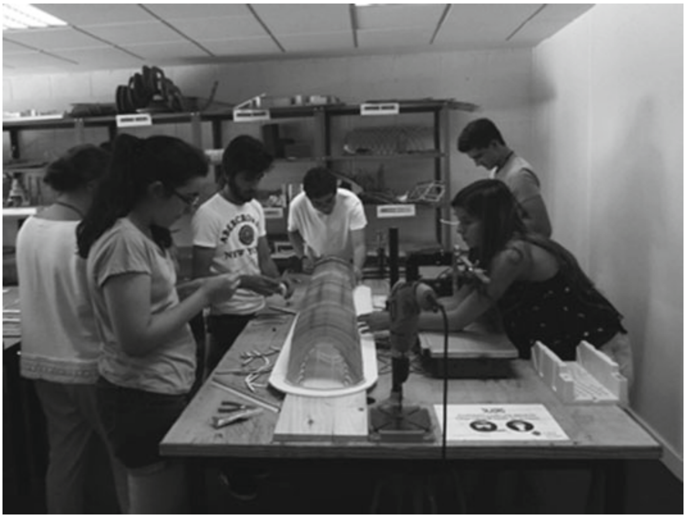

Fig. 7 Session on digital fabrication. Construction of a model of the Madrid-Río walkway

model of the bridge. This model was built using a CNC cutting machine. Students assembled the pieces in just one session. Most of the students had never seen before this type of machine in progress (Fig. 7).

Several senior students and recent graduates with collaboration scholarships at the Institute of Technology were able to share their experiences and difficulties during their architectural studies in a friendly and understandable way with ESO and high school students. These students' advice came spontaneously and were voluntary. Direct contact between senior students with good records and pre-university students was very enriching. In addition, some of the senior students collaborated in assembling the final exhibition and in spreading the workshop through social networks.

San Pablo CEU schools drawing faculty also helped to spread the workshop. It also allowed to confirm that the course contents were interesting for high school students. Coordination among summer workshop teachers was important but also coordination with high school teachers. Many students had yet to complete their pre-university studies so the workshops were complementary training to the academic course they were enrolled.

In addition to the opportunity of taking classes from the degree teachers, another important incentive was the possibility of drawing in the same classrooms in which students draw during the degree. Many summer courses are online, and students receive mostly lectures in theoretical classrooms. Taking advantage that the Form Analysis classroom, Model workshop, Computer Science laboratories and Structure workshops remain empty during the summer period, students used the same workspaces, tools, computers and laser cutting machines as students during the academic year.

Workshops information was reported prior to registration by e-mail and e-mail was also used for the exchange of results between teachers and students. Students sent their digital files through e-mail to the teachers or the course coordinator. They were printed out and displayed in the exhibition held on the last day of the second workshop. Expressive drawings and models made during both workshops were also shown at the final exhibition.

Some images about the development of the summer workshops were uploaded at social networks and at the San Pablo CEU University web. Blogs and publications disseminated the results and the experience of the students. CEU Media also made a small audiovisual piece which collected the manufacture of the model and the students discussed their impressions of the workshop. Several links are available at References on the web (Fig. 8).

According to the teachers, the skills acquired by the students were:

- To differentiate between university degrees in Architecture and Design, and confirm or find out if they had a vocation to study them.
- To increase observation skills, knowledge and respect for the environment.
- To enjoy drawing and overcome previous graphic conditions.
- To draw expressive and definition drawings, build an experimental three-dimensional model and understand the process of making models from digital manufacturing.
- To work in teams more easily and communicate effectively their design concepts.

Among the drawbacks, we can highlight a greater teaching load for teachers and the impossibility to deepen knowledge due to the lack of time. These drawbacks are

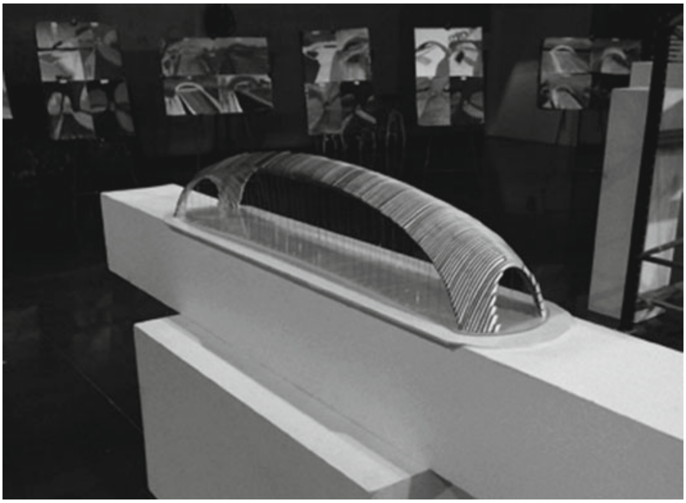

Fig. 8 Final exhibition with the workshops drawings and models

fewer than the benefits that have been described in the objectives, development of workshops and skills acquired by students.

So we can conclude that the experience of the 2015 summer workshops of the Institute of Technology was positive. These architectural graphic expression workshops were a good tool for students to know or confirm their vocation and receive a practical introduction to the degree of Architecture through drawing because:

– Students knew better their interests, aptitudes and drawing vocation in a playful and creative way, without conditions or grades. Probably, students will remember what they learned through this intensive experience in a more lasting way than regular courses.
– Students visited and drew in situ an area of Madrid and a Museum that many of them had not visited before. These visits increased their ability of observation, knowledge and respect for their environment.
– Students deepened their knowledge of Graphic Expression which allowed them to try and guess the many possibilities of graphic tools available at their fingertips such as specialized computer drawing and image processing software.
– Students were able to actively participate, talk to teachers and scholars in a direct and relaxed way and communicate their ideas to other colleagues.

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https://fablabmadridceu.wordpress.com/author/epsuspceu/

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Put Drawing to Sleep

Irma Arribas Pérez

Abstract The type of drawing required to activate the creative process is a specific type of drawing, not descriptive or deductive, but instead performative. Draw as a projecting action and projecting as a drawing manifestation, is the reality in which drawing is considered as activating emergence. Its specificity requires an attention from the action and from the pedagogical framework.

Keywords Performative drawing · Creative process · Emergence

The drawing required to drive the creative process is a specific drawing, performative in nature, able to surface projecting impulses.

While performative drawings allow internal communication between designer and project, descriptive drawings set out in a project communication outside projecting. It is for this reason that descriptive drawings need to tune their graphic narrative capabilities according to the public to whom they address as well as the message they want to show, while performative drawings must pay attention to communication between project and designer.

We can distinguish two ways of drawing required by the project from the distinction made by the language philosopher J.L. Austin between constative and performative utterances. While the first set can assimilate to the drawings which help stabilize and secure the project decisions by representing the imminent reality announcing the project, the latter doesn't announce the decisions, but they help to reach them by playing an active role in the creative process.

This paper aims to explore and share what we have called so far "performative drawing".

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1 Performative Drawing

Several authors have stressed the importance of drawing as emergency trigger in the first stages of the project through:

Drawing as triggering the reinterpretation when it causes "seeing as" instead of "seeing that" (Goldschmidh 1991).

While "seeing as" activates, through the ability of appropriation and inference, a process of change based on the action, the nature of "seeing that" uses reading as a contemplative way to revisit what exists, assuming translation as the only possible movement.

To perceive possible "movements" rather than judge the "seeings" (Schön and Wiggins 1992).

One of the features of design projects is its oscillating movement, moving between dark areas managed by the unconscious, intuition, gestures, and light areas governed by the conscious; this is the construction of questions and getting answers (Español 2015).

Do not ignore the "lateral transformations" versus "vertical" progress (Goel 1995).

While lateral movements allow progress in the generation and mutation of ideas, vertical movements study in-depth details that require these ideas to become matter. On this matrix scheme in which the project moves, the graphic drive must be aware of its position.

The capabilities of focus shift.

Semantic ambiguity and density are innate properties in the drawing that help "discover", through a focus shift, unforeseen aspects that drawing contains, serving as a stimulus to surface.

2 Nature of Projecting

The design process is the action, located in a defined space-time, which articulates the transition from the virtual world to the constituted reality (Zizek 2006). This mission of "letting appear" as a process of specialization between the virtual topology to the current metric has a specific nature that design thinker Nigel Cross set on a third area of knowledge (Cross 2011).

If science is the area of knowledge related to the natural world that uses the "truth" as a screening tool and humanities are the area of knowledge of the human world ruled by "justice", Nigel Cross articulates around technology a third area of knowledge about the artificial world, being "appropriation" specific to it (Table 1).

Table 1 Areas of knowledge

Artificial world	Human world	Natural world
Modelling Pattern-formation Synthesis	Analogy Metaphor Evaluation	Controlled experiments Classification Analysis
Practicality Empathy Ingenuity	Subjectivity Imagination Commitment	Objectivity Rationality Neutrality
"*Appropriateness*"	"*Justice*"	"*Truth*"
Technology	**Humanities**	**Science**

Table 2 Comparative framework of processes between areas of knowledge of science and design

Scientific process	Design process
P>>>>>>>>>>S	P>S>P1>S1>P2>S2>···>Pn>Sn

The different ways in which the relationship between the problems and the solutions are managed provide insight into the natures and the specificities of each of the processes associated with the three specific areas of knowledge (Cross 2007).

– Defined problems/ill-defined problems.

While science does not question the problems but focuses on solving them, design challenges the problems through rethinking.

– Focus on the problem/focus on the solution.

While science focuses on the problem as defined setting for analysis and cause of a course of action towards an optimal solution through a systematic search, design focuses on the appeared solutions as these will help to question the problem.

We could assimilate the scientific process to a linear structure that starts from the problem to the solution after a process of selection and systematic research; while the design process is based on a territorial structure formed by the movement of actions and reactions between problems and solutions, and this movement shapes, evolves, letting the design appear (Table 2).

Drawing is the action that helps the designer to trigger and to coexist where problems and solutions meet. To trigger, since at times drawing instigates the relationship; and to coexist, since there are time frames in which the dynamics of actions-reactions is generated by the inertia of persuasion propelled by drawings and managed by drawing.

"Whom do drawings speak to? They say nothing; they are only decoys to stimulate the interested projections of receptors" (Segui 2010).

3 To Project by Drawing

As drawing is the action that sets in motion the process of the project, we will base upon the classification of figures proposed by anthropologist Octavi Rofes Baron from Deleuze's writings on painting and texts on drawing by architect and professor of Analysis of Architectural forms at ETSAM, Fco. Javier Segui de la Riva[1]:

Figure-cliché: Referring to common and shared representations, key figures in societies oriented to the generation of the convention. It is under this kind of figures that culture is built. The *figure-clich*é acts as motivation for differentiating inventive actions, responsible for renovating the conventions that avoid stagnation. In the case of architecture, it corresponds to the image of the room, as Segui says, which everyone can represent but not everyone can draw.

Figure-figural: It is the result of the differentiating action that criticism has on the figures-cliché. In architectural design, unlike art, this figure has no positive entity, it is a "distortion" or as Segui puts it, an "invisible world" that requires creative interpretation, 'looking like' in order to give it meaning.

Figure-projecting: It is stated as a specific form of conventionalization that acknowledges in the *figure-figural* the condition of possibility to develop a project. Drawing moves from an "invisible world" to a "miniature world". We mean conception or ideation drawing which contains the inventive items of the architecture and design project.

Figure-figurative: It is the conventional drawing representing the project which transmits the necessary data for its public understanding and possible execution. The difference with the *figure-cliché* is that the drawing shows a reality that exists only in the drawing, thereby increasing iconic resources, such as photo-realism, or symbolic resources, such as shared technical drawing codes.

By this classification, Octavi Rofes Baron places the action of the creative process as going from the *figure-cliché* to the *figure-figurative.*

4 Drawing by Projecting

Understanding the design process as the configural action that needs drawing to start movement, I hereby explain five graphic procedures aimed at training for the practice and acquisition of habits to draw and motive the project, of performative nature, necessary in the internal communication of projecting.

[1]Personal communication (11-09-2015).

5 Doodling

Doodling refers to drawing with free gestures, without any architectural graphic code.

"I do not copy or think anything precise; I attend the show of this decisive and occasional dance" (Segui 2010). It is in the interpretive look, as an individual way of inhabiting the graphic spots where the emergence of an idea, circumstance or opportunity sets.

Drawing doodles records the update of virtual images that inhabit the birthplace of imagination, where memory, imagination and unconscious coexist (López-Galiacho 2014).

The images that appear in dreams and those generated after doodling have in common that are caused by a process of updating the virtual. In dreams, the activity is governed by a process of infinite update without any possibility of being present, since it is the soul that hosts the process. Drawing, as externalizing action, allows the updated virtual image *image-perception* to become *current-image*, being the matter condition of drawing what makes it possible-current (Deleuze 1987).

This externalization is a constructive and free action, where drawing, draughtsman and draw generate a trio in productive harmony, the result of graphic communication based on configural lines pressed, gestured, sensual, which are building from touching a territory that the look will conquer gently. Drawing ends when the illustration, in its maximum degree of ambiguity, has been discovered by the creative interpretation, after which a new process of drawing begins based on a type of coding of what has appeared in order to ripen the project and be able to express in the public sphere.

Doodling is a highly energetic and intimate activity. The pulses are settled in many codeless graphic spots, proposals that may be abandoned if the marked strokes do not allow the conquest of the world that the drawing aims to communicate. The time spent is not organized or scheduled, it is not a condition attached to doodling, as well as the action space or registration is not significant. Man only pays attention to channeling virtual update vectors through a relentless plot by tangled lines that collect, organize, relate, draw lines on abstract space that is taking shape.

6 Hypercoding

While in doodling what is intended by drawing is to outsource the virtual images updating process, revealing thus an illustration of maximum ambiguity about which the creative interpretation through the appropriation that the look practises to bring out the architectural project; in the process of hypercoding, updating does not only start in the scope of virtuality.

We can divide the cliché images into virtual and real. The first ones incite doodling and the second ones the graphic hypercoding processes. In this second process, the real images of fixed nature and limited capacity to withstand recombination and handling processes are attracted to the designer's realm of the virtual thanks to memory. For this meeting to be productive and drawing to become projecting, the drawing of the perceived physical space gets in touch with the purest imagery of the designer through a communication that requires a type of descriptive code, non-representative, about which interpretation will be necessary (Fish and Scrivener 1990).

In the hypercodification practice, we can differentiate aspects related both to communication and to form.

The communication established between the real and the virtual, as quoted by Fish and Scrivener, needs certain descriptive codes to put the two worlds in relation. The designer creates these codes according to the pulses generated by the meeting between reality and virtuality with the intention of opening the imaginary making drawing to take the image to a high degree of ambiguity where emerging after the interpretation is possible.

Once the projecting process goes beyond the emergency, the code is used as an external, public symbolic resource.

In terms of form, the hypercodification does not work in watertight compartments between 2D representations of space, floor plans, elevations and sections and 3d, axonometric and conical perspectives; rather it hybridizes and in this sense it creates a spatial drawing hypercode specifically developed according to the exploratory demands that the project requires when drawing. Fugal sections, fragmented plans with reference sections, conical perspectives related to 2D representations.

The potential of this hypercodification based on hybridization has an effect on the high degree of connectivity under which it settles, and emergency opportunities open thanks to the visible relational field that drawing is capable of displaying and the designer's eye able to see.

Under this territorial aspect, the drawing is filled with notations, marks, changes of scale, representations in two and three dimensions, but all of them linked by visible or invisible lines drawn on a support that collects emerging architectural explorations. The movements of drawing are slow and with an effect, freezing interesting moments through the use of tracing papers that redraw opportunities, before the tireless exercise of project drawing hides the drawings with which it is projecting.

7 To Disenchant

To disenchant is the drawing process by which a highly ambiguous and nutritious image, sensorily active and provocative, the signal of an emerging of the creative process, is taken off the mystery by undressing it in order to extract its essence with the intention of serving as the foundation of projecting until further notice.

We shall call *dream image* to that image on which the disenchantment will fall through drawing. This *dream image* is the graphic result of a space built in the imaginary that is externalized undoubtedly on a three-dimensional image.

To disenchant the *dream image* through its architectural representation by plan, section, elevation, axonometric, perspective, etc. will allow investigating in order to find out which are the architectural natures, the hinted worlds that print its essence. This analysis exercise opens a round of inspection and questions that reflect in the drawings that are generated.

The drawings are expanded and sequenced, each showing a different approach as a result of the look practised on the *dream image*. The designer, with the use of notations, lines and spots, carefully and neatly presents the material that will allow him to start maturing the project through the scoring of problems and solutions according to what appeared and to the variants provided by the exercise of disenchanting the *dream image*.

8 To Saturate

To saturate a drawing is an action that generates more questions than solutions. One can ensure or find possibilities for the project if one stresses an image in the last phases of the project when it is apparently comfortable with the decisions that have been taken after the exercise of projecting.

Space narrative drawings in three dimensions on which the architectural project is presented and represented, of an “almost pictorial” nature, are *figural-figures*, completely unambiguous and totally explicit. The process of saturation will develop about them through the use of new tools of incision, actions on the support or any kind of games with the base image.

To saturate allows disturbing overloading to bring out possible architectural events that were not considered in shaping the imaginary image of projecting. This allows the designer artist to be placed out of the project, to gain perspective and to generate a series of conditional questions “what if…?”, in order to start the graphic act of saturating.

Stains and density fill the drawing with ambiguity taking it up to a degree of uncertainty that opens possibilities for the interpretation of graphic strokes that have disfigured the comfortable image as a result of the management phase that the procedural gravity had set.

The drawing is saturated with the presence of “other” shadows, lighting conditions, visual relationships, occupations, and so on, as well as the “qualification” of architectural decisions already taken: cuts, materials, rhythms or presences.

To saturate is the dying process of a drawing that the designer does to provoke the project through disturbing the drawing with an obsessive drawing.

This process allows us to observe the capabilities of the represented, the essence of vitality, the elasticity of the space body, the infidelity of drawing and the possible communicative clumsiness between designer and project.

The process is slow and intense, provocative and it requires a great lot of attention because the aim is to induce an emerging opportunity, in this case from questioning and criticism.

9 To Vary

If you vary the graphic instrument, it will allow a distinct trace and thus to communicate different aspects of the same architectural design.

This exploration of the architectural body due to drawing the same reality using different graphic tools widens the designer's look who instead of looking for, finds in his strokes realities to be addressed, opportunities or inaccuracies.

Redrawing the same perspective, *figure-figural* of a project, in monochrome pencil, spray, collage or 3d digital techniques, helps to appear, thanks to the narrative capabilities of each tool, aspects related to shape, density, materiality or relationships.

To vary is like *to saturate*, an exercise of questions and criticism of the project in its mature stage; when the only way to keep asking questions is turning away from it and disturbing it to see if the maturity gained from the design process keeps it stable or otherwise, with the graphic movements, the project has doubts, instabilities or opportunities to be considered or solved.

With the intention of placing these 5 procedures and retaking the 4 figures that the anthropologist Octavi Rofes Baron exposes, we can develop a scheme that makes visible the emergency zone, just after the appearance of the *figural-figure*, a moment of maximum ambiguity, and as a result of their creative interpretation.

Both the *figure-cliché* and the *figure-figurative* have lower ambiguity and a decrease or an increase to the strip of creative interpretation may mean an emergence.

Since the design project is based on a continuous friction between problems and solutions, the process of moving from the *figure-cliché* to the *figure-figurative* is reversible, since going through the emergency phase is often necessary several times or at least caused its approach to questioning the project itself. A remarkable aspect to consider reversibility is that once the creative process starts the reversibility will not revisit *figure-cliché,* because it is while at the emergency strip that revisiting will take place as often as required by the palpitation of the project, until the project appears when projecting is dead.

This strip of emergency based on the creative interpretation of the *figural-figure* is parallel to the description that the design theorist Donald A. Schön makes on the process of designing. To Schön, designing means maintaining a "reflective conversation with the situation" through three scenarios present in three actions: "Sees > moves > Sees again". While "sees" records the information, "moves" is the action of displacement generated by drawing on visited information, where "sees again" allows us to construct meaning by recognizing, detecting, finding out and appreciating (Schön 1992).

10 Conclusions

The next conclusions on the performative drawing are related to projecting, as well as to the specific pedagogic frame required.

– Drawing by projecting

The architectural drawing embodies the act of projecting, which is only one intention of configuration that requires a body: a drawing, and action: drawing, to present it. In the configurational action not only are implicit the trace actions to let appear, but also the ones to interpret the dialogue. Masaki Suwa and Barbara Tversky described "read off" as the ability to perceive invisible functional relationships, linked to the perception that every architect should take to stimulate thought (Suwa and Tversky 1997).

In this sense, the debate should focus on the manual drawing and the computer aided drawing not from the action capabilities of each technique for generating the drawing, but also in the capabilities offered by each technique in relation to drawing and this in relation to the project process.

The digital present is more directly programmed to represent and "easily recognize" rather than to "perform best" those images that it is capable of producing. I consider two ways to deal with the case:

From doing. To disobey the "assistance" of the computer drawing or to obey the "allowed" computer drawing?

Even though programs are designed for a particular mission, there is as in any built structure a capacity to disturb, hold, appropriate, play, breaking over it for other purposes that are not under which it is programmed. In the case of drawing, with the opening of what is imaginary as deficit within the possibilities of computer design, we can take the idea of constriction, belonging to Oulipian thinking, as a framework for productive and creative opportunities. Therefore, it seems necessary to disobey the protocols with which computer-assisted drawing programs decide "to attend", caring more for the drawing than for the act of drawing.

The reality is that the very act of disobedience is not even necessary because no help is needed. If we change "to attend" for "to allow" it is not necessary to disturb the tool, but to get hold of it to activate a particular drawing.

From looking. Development of a critical and interpretive look of the generated images.

Reaching the end of a process of "computer-assisted" drawing seems to offer guarantees on its assistance of making the project visible safely, as long as the processes that it takes follow the parameters of the program's guide.

The images that rendering favors, praising recognition over the interpretation, allow an analytical intrusion that opens a great range of questions to answer and speculation to make, thanks to the descriptive image capabilities, testing the imaginary of the project and thus the action of projecting.

In this sense, I believe that the orientation for the development of opportunities in the field of new technologies must be closer to the capabilities shown in parallel by drawing by projecting and projecting by drawing.

– Actions, relationships, agents, academic structures to project by drawing.

Academic structures should look after learning to draw with the ability to nurture, care for and lead a project process. In this sense, Fig. 1 exposes through 5 procedures and in relation to the creative process gymnastics able to train students on their journey through projecting.

Just as James Joyce claimed that writing Finnegans Wake, he had put the language to sleep, altering its regular relationships with the "day" reality (Ellmann 1991); "to put the drawing to sleep" is the action that allows us to bring the creative process closer to the emergency zone through drawing.

The five graphic actions that I announce: doodling, hypercoding, disenchanting, saturating and varying seek to get closer to emergency from different parts of the project process thereby opening the range of locations, processes and strategies that we, teachers of drawing, need to cover, thus visualizing whether our teaching plans and associated subjects covered, and to what extent, the needs of performative drawing.

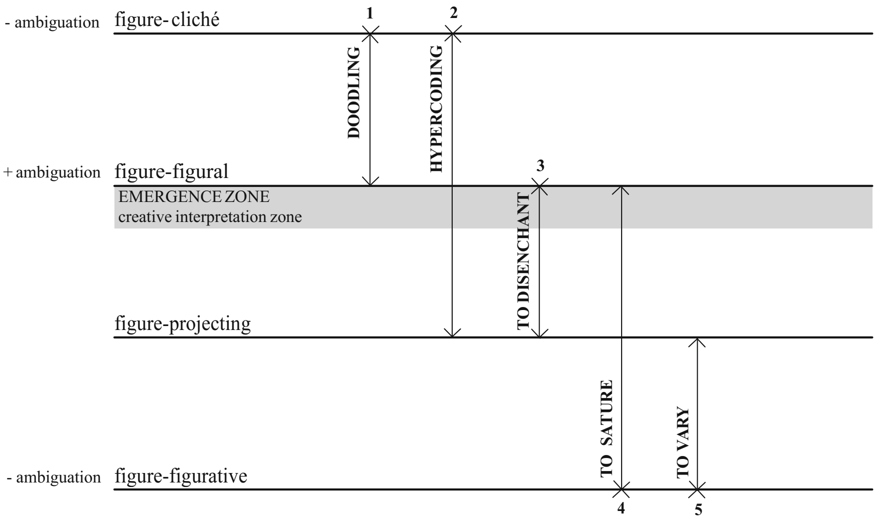

Fig. 1 List of graphic procedures and figures in space/time of the creative project

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The Aesthetic Influence of Photography in the Representation of Architecture

Amparo Bernal López-Sanvicente

Abstract Spain architectural representation has, over the past fifty years, evolved from abstraction to photographic hyperrealism. In the nineteen-sixties, when black and white architectural photography had gained artistic independence, the contrasting duality of black and white reflected the artistic quality of architectural drawings published in specialist journals. The aesthetic criteria of architectural representation remained in vogue, even when computer-assisted design had become commonplace. The real graphic revolution has developed since the late nineteen-nineties, almost coinciding with the new Millennium, when architectural drawing abandoned abstraction for the photographic hyperrealism of digital imagery and video.

Keywords Architectural representation · Photography · Visual arts

1 Architectural Representation Through the Lens of Photographic Analogy

Photography and drawing are separate languages of graphic expression that use different techniques for visual communication, but both share relationships and analogies with the reality that they represent. There are drawings and photographs that resemble each other, so much so that they may even be confused, although their origins still differ. Art critics and traditional historical accounts have not lent sufficient attention to the reciprocal influence of photography, drawing and the other visual arts, because they categorized photography merely as a technical procedure and therefore considered that the traditional arts set the trends (Mulet and Seguí 1992, 279).

First, there were the drawings of architectural treatises by Alberti, Di Giorgio, Colonna, Serlio, and Palladio and later on, in the 12th century, the engravings that

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Fig. 1 Nicéphore Niépce, *View from the window in Le Gras*, 1826

faithfully reflected the architecture of Rome, which filled the suitcases of travelers returning home with pictures to illustrate their tales. In the early twentieth century, with the arrival of avant-gardism, photography rather than drawing and painting imposed itself on the representation of architecture, as a new technology, synonymous with the values of modernity. This new language of analogies that revealed architecture to us through the physical reality of the photograph also conditioned architectural representation. The concepts of light and shadow, architectural volume and space, matter and void, were symbolized in the duality of black and white in the photographic image, in the positive and negative of the architecture.

In the first photograph taken by Niépce in 1826, which captured a view of the city of Le Gras looking through a window, the white defined planes of light, while the black configured the two-dimensional representation of the architectural volume. White represented an empty hole and black materialized the physical density of the space and the color gradient between those two extremes suggested depth and spatial continuity. The language and the technique of photography contributed conceptual and expressive density to the gradient between white and black (Fig. 1).

The edges and textures are clearly defined in the foreground of the photographic image and these blur as the focal depth is surpassed. The photograph gives us a new way of representing architecture, using the composition of smudges of shade and the gradient between black and white as well as linear definition, to fill out volume, to define depth, and to recreate a three-dimensional view from the abstraction of a flat image.[1]

[1]All gradients possess the virtue of creating depth (Arnheim 1985 [1954], 343).

In drawing as in photography, white is the void, nothingness; excess light that erases the image. It is the blackness that draws the architecture; the shadow. However, although this analogy is established in the final result, the genesis of a drawing is the inverse of the photographic process. In drawing, the forms usually appear in black on a white background, while in photography, it is the whiteness of the light that draws the shapes in the shadow. When the images are technically manipulated and the concepts of both means of expression are mixed, photography may be assimilated to drawing and drawing imitates photography (Fig. 2).

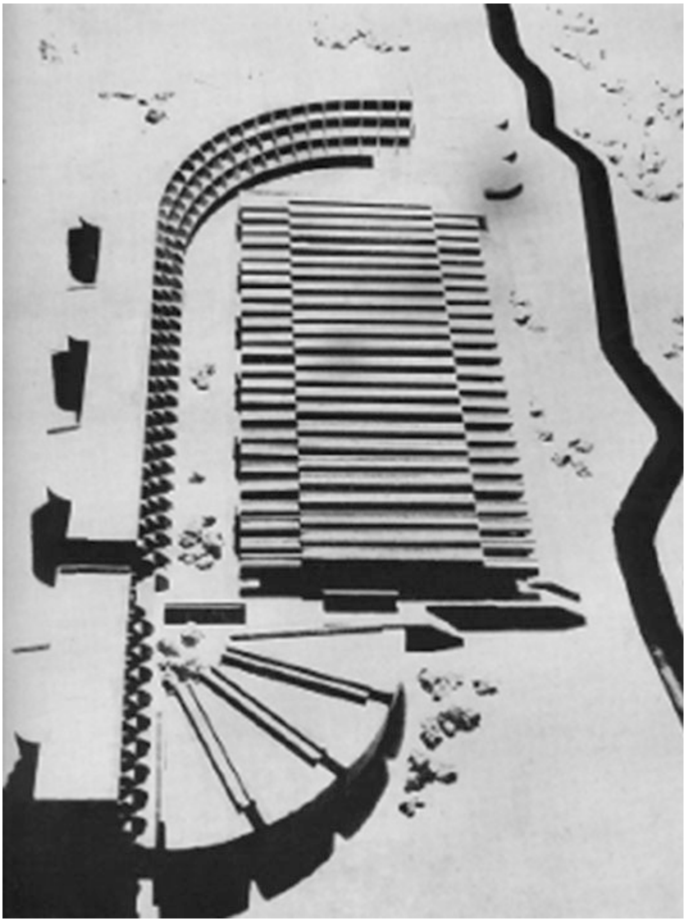

Fig. 2 Antonio Fernández Alba, École Les Samuels, Oise, Paris. 1968

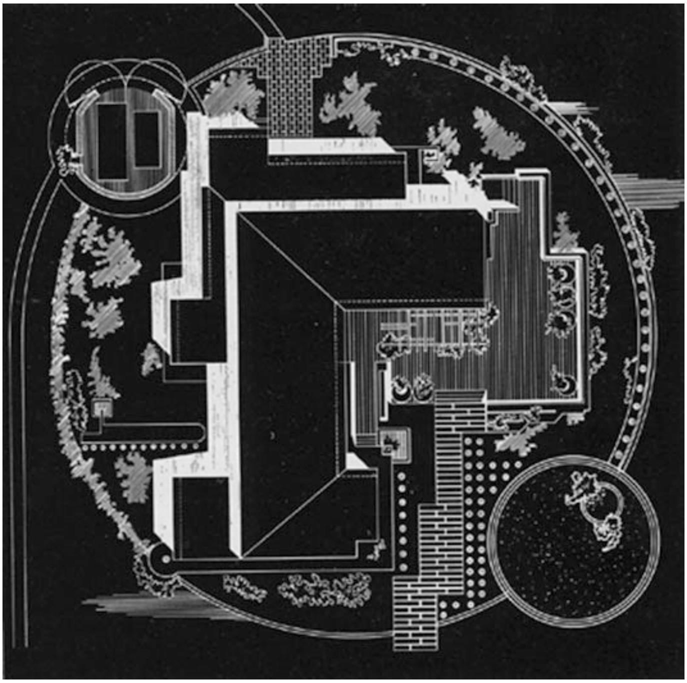

Fig. 3 Antonio Fernández Alba. House plan in the village for the nuclear power plant of Zorita, 1965

In photographs, three-dimensional perceptions cease as the gradient of black and white light is reduced and they are seen as drawings on a two-dimensional plane. Architectural drawing experiments with the conceptual assimilation of the photographic negative in the representation of architecture, when it reproduces the drawings in white on black.[2] The reproduction of drawings "in the negative", employing the inverse of their usual production technique, gives rise to a paradoxical effect from the two-dimensional viewpoint, but beyond mere formal emphasis, the duality of the contrast of either white on black or black on white indistinctly expresses the concepts of space and architecture as the positive and the negative of the same reality (Fig. 3).[3]

[2]In the negative, thanks to the inversion of black on white and of white on black, the trivial naturalism of the photography is surpassed and a new world of optical experiences is constructed of lively and, in a certain way, graphic charm (Steinert 2007 [1965], 275).

[3]On the manipulation of the images, seeking a graphic or photographic interpretation, see (Bernal 2012, 189).

2 The Influence of Photographic Criteria in the Representation of the Spanish Modern Architecture

In the early twentieth century, photography established itself as a satisfactory medium for the representation and diffusion of modern architecture. In the photographic images of that time, the purity of the lines that defined their forms and volumes are complemented by the gradation of the textures of the different depths of field and projection of shades. In addition, the distortion of contrasts means that images may be created that skip between realism and graphic abstraction.

In Spain, in the twenties and thirties, photographers such as Luis Lladó and Margaret Michaelis adopted technical and stylistic approaches proposed by the Central European avant-garde, who identified with the formal novelty of the architecture that they represented. Unusual points of view, diagonal compositions within the frames, the negation of volumetric perception of perspective through frontal focuses, which converted the architectural volumes into drawings on a two-dimensional plane, contributed experimentation and dynamism to the representation of architecture.

Following the parenthesis of the Spanish civil war, true architectural modernity commenced in Spain in the nineteen-fifties; for the communication of its principles, its best ally would be found in architectural photography. Photographers such as Pando, Kindel, Paco Gómez and the master Catalá Roca, among others, contributed through their photographs to the creation of an image of modern architecture in Spain, as, even though modern architecture was communicated through images, these in turn became a source of inspiration and a model for architecture.[4]

In the professional journals of the nineteen-sixties, architectural photographs were published alongside the architectural design plans, which at that time were still clearly hand-drafted in the studio.[5] The design plans were drawn by hand and their expressiveness depended on the contrast between the white paper and the black charcoal or ink outlines, as well as on layout and composition. Moreover, the simplicity of the shapes and volumes of modern architecture left no room for the calligraphic embellishments in the drawings of architectural historians, nor for the variety and the richness of form and texture of traditional architecture.

Perhaps in the search for a certain esthetic coherence between the visual power of photographs and the representation of architecture, design drawings began to enrich the abstract expression of their plant views, elevations and sections through shadows and textures, following the aesthetic influence of photography, the duality

[4]On the photography of modern architecture in Spain, see (Bergera 2014).

[5]In this article, the documental sources in the nineteen-sixties and seventies were the publications of the two journals Arquitectura y Cuadernos de Arquitectura, especially the articles dedicated to architectural competitions.

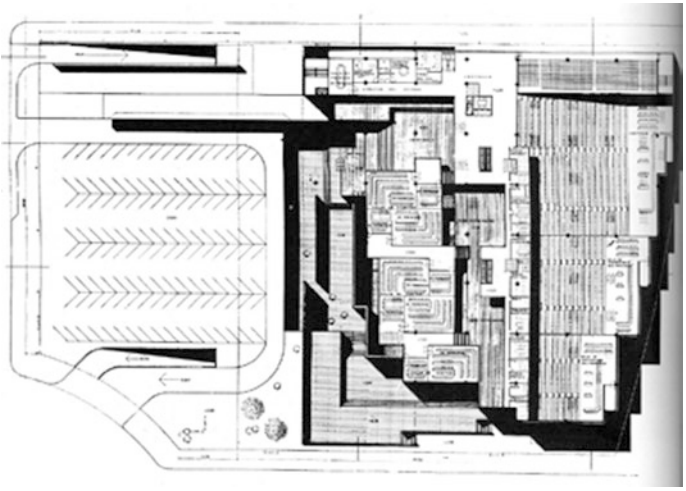

Fig. 4 Corrales, Molezún, Mata. 3rd prize in the architectural competition for the Exhibition Palace of Madrid, 1964

of black and white contrast, which also prevailed in the rest of the visual arts, the communications media and the print media.[6]

Architectural representation reached the height of its expressive development, masterfully exploring the possibilities of the language of dimensional abstraction and the graphic resources of black and white. For over a decade, generations of architects contributed to the development of this language following the guidelines of the drawings by the great masters.

Shadows were used to express the depth of the different fields of view and to emphasize volume and the area of urban influence.[7] So, shadows were not only drawn on the front and the top views, but their plant view of the layout was used to enhance the sculptural perception of the architecture (Fig. 4).

The final composition of the drawing and its shadow expressed in the duality of black and white was done with an expressive end in sight for the project. Therefore, as a graphic resource, its drawing can even forego the condition of a representational analogy of sunlight cast on the building, as its definitive intention is not the representation of shadow in itself, but the effect provoked by its darkness on the perception of the architecture.

Project documentation reached its utmost expressive virtuosity for the to competitions, where in the absence of a report on the finished building, the photographic montages with the design specification documents and photographs of the models should emulate the effects of photorealism (Fig. 5).

[6]On documenting the relations between photography, the visual arts such as pop-art and graphic design, see (Zelich 1988, 82).

[7]On the plastic sense of shadow, see (Casado 2011, 216).

Fig. 5 Luis Laorga & José López Zanón. Photomontage for the competition organized by the Escuela Técnico Superior. Ingenieros de Caminos, Canales y Puertos (Higher Technical School. Engineers of Roads, Canals and Ports) in Madrid, 1963

3 The Beginnings of Digital Tools in Architectural Representation

During the seventies, despite the extensive use of color in the mass media as much as in the cinema, on television and in specialized journals, architectural photography and the representation of design projects hardly underwent any conceptual changes with regard to the aesthetic criteria of representation (Fig. 6). In the schools of architecture and professional studies, design projects were still hand drawn and the expressiveness of plans and the visual communication of the project essentially maintained the earlier aesthetic principles.

Spain would have to wait until the end of the nineteen-eighties, but above all in the nineteen-nineties for the introduction of computer-aided design (CAD). CAD drawing began to replace studio drafting because of its ease of processing, modification and reproduction of the plans. However, at first, there was only an instrumental change in the layout, as the codes and stylistic resources of hand-drawn design remained in practice for over a decade, without substantial changes prompted by the new technology.

The evolution of architectural representation in Spain at this stage can be documented through the competitions and all the projects realized for the two cultural events that, in 1992, catalyzed the modernization of Spanish architecture; the Universal Exposition of Seville and the Barcelona Olympic Games, which were published in such journals as El Croquis, Arquitectura Viva and A&V among others.[8]

The published projects were drawn with CAD, but their representation still reproduced the methods and the techniques of hand-drafted documents. The plans continued to be printed in white and black, together with side views and perspectives colored in by hand with paints or watercolours and the constructive details were illustrated in hand-drawn sketches (Fig. 6). The perception of volumetric

[8]The journal *El Croquis* 48 (1991) and 55/56 (1992b) published the reports of completed buildings, while we were able to document the plans and models of competition entries in the journals *A&V*. See *A&V* (1990, 1991, 1992a).

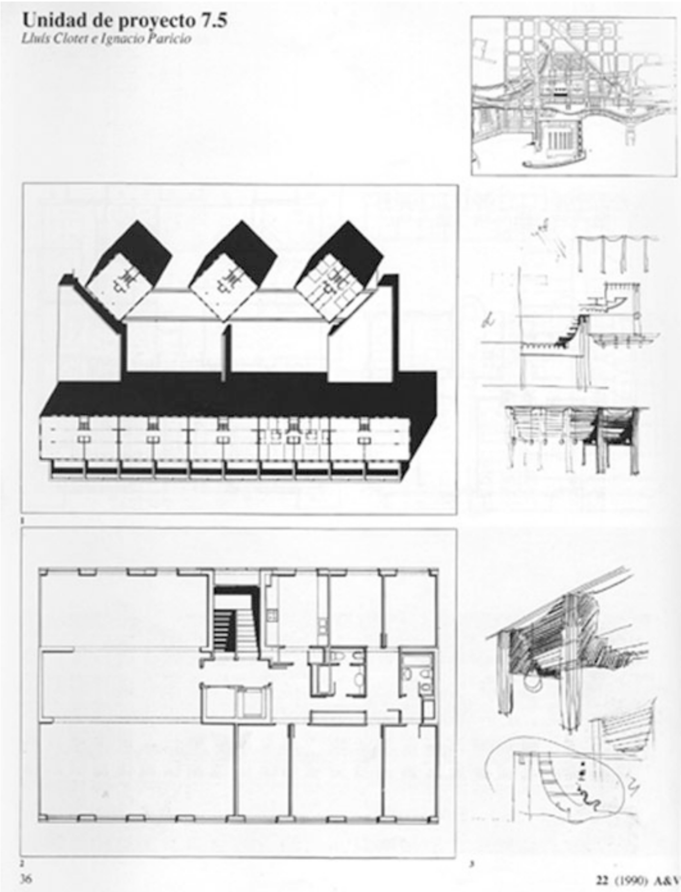

Fig. 6 Lluís Clotet and Ignacio Paricio. Apartment building in the Olympic Village. Barcelona, 1992

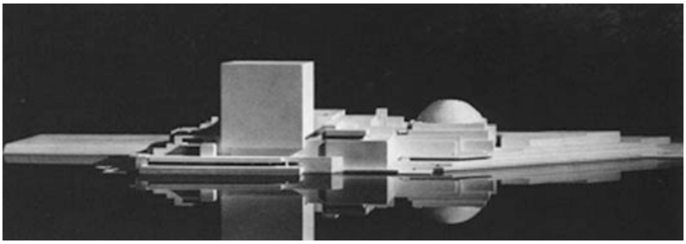

Fig. 7 Julio Cano Lasso. Pavilion of Spain. Seville, 1992

reality and scale was shown with photographs of the models, in which the level of detail neither anticipated the final image, nor recreated the use of urban space (Fig. 7).

The representation of the design was still supported by the hand-drafted quality of drawings and models. Despite the instrumental facilities offered by CAD, it had yet to assume all of the potential expressiveness of the new tool. As we assume that in architectural representation we “draw, recycle or enlarge drawings that somebody drew before” (Minguedía 2011, 102), many drawings by many architects would be necessary, so that collectively the drawings done with the new digital tool would attain their own aesthetic autonomy and would substitute drafting by hand.

4 Photographic Hyperrealism and the Virtual Architectural Experience

In its traditional conceptualization, the representation of architecture was an abstract language, of universally accepted standards, with an encoded message for technical interpretation. The plans were not always easily understood by those outside the architectural profession. The true graphic revolution took place when, thanks to the possibilities offered by computer tools, the representation of architecture had included among its objectives, universal communication by means of a visual language.

Since the late nineties, almost coinciding with the turn of the century, both in the teaching of graphic expression and professional work, a transformation has been developing in which the communication of architecture left abstraction behind, to assume virtual hyperrealism and the subjective perception of the future user.

In a hand-drafted design project, conic perspectives, traced out by selecting the appropriate viewing points, presented the image that best matched the spatial perception of the naked eye. However, because of the intrinsic difficulty of technical drawing, it was not a common means of representation outside of the academic world, proof of which is the scarcity of such perspectives published in journal reports.[9]

Architectural modeling and rendering programs become essential tools in the late nineteen-nineties in Spain. None of the reports on the design projects for Seville and Barcelona in 1992 contained a computer rendered plan; merely a few examples of simple volumetric perspectives captured from a computer screen, in which plain colors were used to evoke a figurative representation (Fig. 8).[10]

[9]In the articles that the journals *Arquitectura* and *Cuadernos de Arquitectura* dedicated to competitions during the nineteen-sixties, the perspectives were scant, photographs of the models and axonometric perspectives predominated.

[10]Figure 8 shows a captured computer-screen image that was published in the report together with the project plans. Cfr. Lluís Cantallops, Miquel Simón. 1990. “Unidad de proyecto 5.4”. A&V *Monografías de arquitectura y vivienda* 22:46.

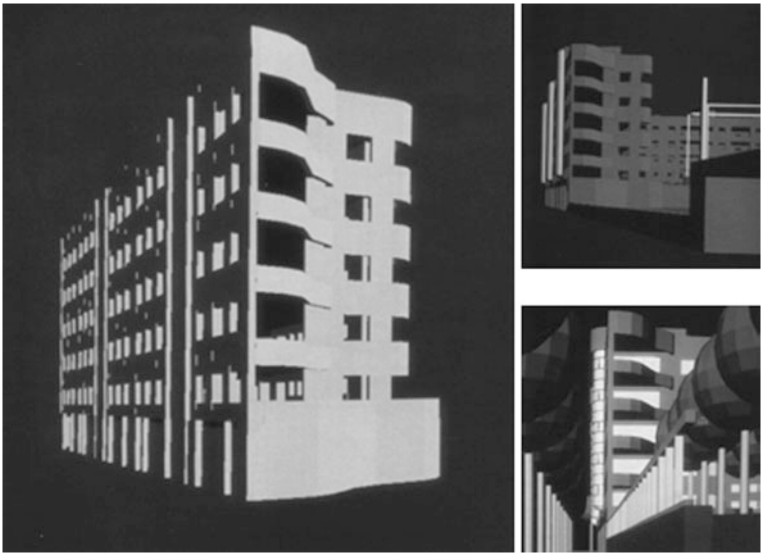

Fig. 8 Lluís Cantallops, Miquel Simón. Apartment block in the Olympic Village. Barcelona, 1992

But from that time, the graphic evolution of CAD underwent a quantum leap forward, thanks to the collective work of many professionals drawing on the basis of previously existing drawings. At present, renderings obtain images in which any possible photographic approach may be visualized with a final result that reproduces the texture and the color of the materials, the reflections and the lighting effects and the future animation of the space. The rendered image at that point becomes the most effective and universal communication medium (Ochotorena 2012). It is no longer necessary to understand the conventionalism of two-dimensional codification, because the representation of the architecture is shown as a virtual reality (Fig. 9).

In the same way as the graphic criteria for black and white abstraction, which developed until the nineteen-eighties, graphic resources that enable digital tools were used to highlight the design project beyond the possible reality and not to reproduce reality. Architectural renderings from the beginning have evolved into hyperrealism, producing digital images that may or may not be true to life, even if they appear so. Their aim is to anticipate reality, presenting it in an idealized way.

The end-point of this process of evolution towards hyperrealism is not the virtual image, because like the photograph, this process only presents a static view of the project. In terms of abstraction, a photograph could capture the building and convert it into an iconic image. But, when embarking on virtual hyperrealism, the communication of architecture also requires incorporation of the dynamic experience of its perception through video.

Fig. 9 Richard Rogers-Estudio Lamela. Digital image in the architectural design competition for Terminal T4. Madrid, 1997

Fig. 10 Agence Ter & Ana Coello Llobet. Images of the architectural design competition Plaza de les Glòries. Barcelona, 2014

At present, the development of information technology permits the generalization of video production and has become an indispensable tool for the visualization of projects, because they offer us the opportunity of living an architectural experience before its construction (Fig. 10).[11]

5 Conclusion

The condition of graphic expression as a language of analogy with reality has always sought the best representation of architecture in its scale, forms and volume. In each historical period of architectural representation, from drawings, engravings and outlines, to digital images and videos, all the tools of graphic expression have used their own codes and resources to manipulate reality and to enhance the image of architecture. The aesthetic criteria of architectural representation remained in vogue even when computer-assisted design had become commonplace. Hand-drafted technical skills and two-dimensional abstraction are assumed to be artistic qualities of the language. However, in digital images and video, the distortion is more artificial, because these techniques present us with a virtual architectural construction in which we can almost experience the sensations of future users, although it is merely an appearance and the project built will not always correspond to the expectations awakened in its representation.

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Survey, Model and Multimedia Communication: From Teaching to Research

Manuela Incerti and Stefania Iurilli

Abstract This paper proposes the teaching experience of the course of Advanced Survey and Techniques of Representation (Five-year master degree in Architecture, Ferrara), whose main theme was the imposing monumental complex of San Michele in Bosco (Bologna). In recent years our research team has developed models and digital media products, focused on this theme, and on other issues of historic architecture. These products, both interactive and not, are useful for the communication of research results and the dissemination of complex and layered scientific contents. These experimentations undeniably represent the future of museal communication, and their results can be shown to the students as a possible field of research, but also as a job opportunity.

Keywords Teaching survey techniques · Teaching digital drawing · San Michele in Bosco

1 The Particularity of the Ferrarese Formative Model: Integrated Teaching (M. Incerti)

During the five-year master degree in Architecture, the teaching of drawing is imparted in three courses over the three semesters, each of which is made up of two modules regarding the discipline of 'drawing'.

This paper describes the experience of integrating the teachings of Advanced Survey I and Techniques of Representation II (hereafter referred to as RIL1 and TRA2), characterized by the temporal and thematic continuity pursued by the teachers. The chance to work thoroughly, for two academic years and two semesters, on the same great theme (San Michele in Bosco, Bologna) offers students a

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high level of detail on the topics. At the same time it is possible for us teachers to build a trail to accompany the growth of their skills, culminating with the creation of three-dimensional drawings of great complexity. The results are often remarkable considering that it is a first approach to modelling and rendering for the students.

During lectures, the students' work is accompanied by the teacher's presentation of their research results on the same subject. These results, related to the dissemination and multimedia for cultural heritage, are the natural evolution of the experiments also conducted in education. Learning about these possibilities is a significant stimulus for the students, which increases their interest in the subject, making them fully aware of the potential of their newly acquired knowledge. The teaching experience is therefore inspired by the logic of the knowledge triangle (education—research—innovation) described and the Conclusions of the EU Presidency—Brussels, 8–9 March 2007.

2 Teaching: From Direct to Advanced Surveying (M. Incerti)

The monastery of San Michele in Bosco, now the seat of the Rizzoli Orthopaedic Institute for more than 100 years, is located in Bologna on a terrace of 133 m, which scenically overlooks the city, and the plains of Emilia. The first unequivocal evidence on the presence of a church and a monastic congregation dates back to 1217, year when the first phase was documented and followed by at least 4 other mentions until the seventeenth century interventions.

The impressive complex has a maximum size of approximately 180 × 80 m and is spread over three main floors. Among the most relevant environments surviving the devolution and the nineteenth-century transformations necessary for its conversion into or thopaedic hospital are the three cloisters, the church, the refectory, the prestigious library, the monumental staircase and the Putti study (Figs. 1, 2, 3 and 4).

The position perched on the hill has made it difficult to carry out survey operations, especially on the west side, the entrance side of the church, where there is only a small, 10-m long churchyard. The direct survey was conducted on all the interiors and part of the exterior elevations, and covers today 3/4 of the total area of the first and second level. The direct survey campaigns (still taking place) started in 2011 with the Survey Seminar "Measuring the sacred" of RIL1 Integrated Course (integrated with TRA1, 9 cfu), the Department of Architecture of Ferrara (2011–12, 2012–13_Prof. M. Incerti-Prof. U. Velo; 2013–14_Prof. M. Incerti-Prof. G. Lavoratti; 2014–15_Prof. M. Incerti, Prof. U. Velo). The teaching experience requires students and faculty to remain on site for 4–5 days supported by tutors. The measures taken during the day by the students, divided into working groups, are then returned to the CAD in the evening in order to check the validity and consistency, preparing in this way the appropriate additions and checks to be made the following day.

Fig. 1 Drawings of the Corso Integrato TRA2, AA 2013–14 (Prof. M. Incerti, Prof. S. Iurilli), studenti: Giovanni Baldo, Alessandro Balzan, Michele Croce, Matteo De Venz. Model and render of the Chiostro di Mezzo or del Pino (Arch. Pietro Fiorini, 1588) with a simulation of the quality of the space prior to the closing of the arcade dating rom the late 1800

Students are required to return floor plans in CAD, elevations and sections on a 1:50 scale of the assigned lotto (400 m^2) and, in addition, an architectural detail each (scale 1:20, 1:10 or 1:5). Furthermore, representations of the façade material must also be carried out, elaborating the photographs using a geometric image rectification software (orthophoto), (RDF, IUAV, Venice). The development of two posters, one narrative (historical and document research) and the other methodological (description of straightening procedures) conclude the digital restitution part of the second semester of the first year.

Alongside the direct survey, an instrumental survey campaign was carried out (Leica 3d disto), prevalently performed by faculty, which took 26 days: the

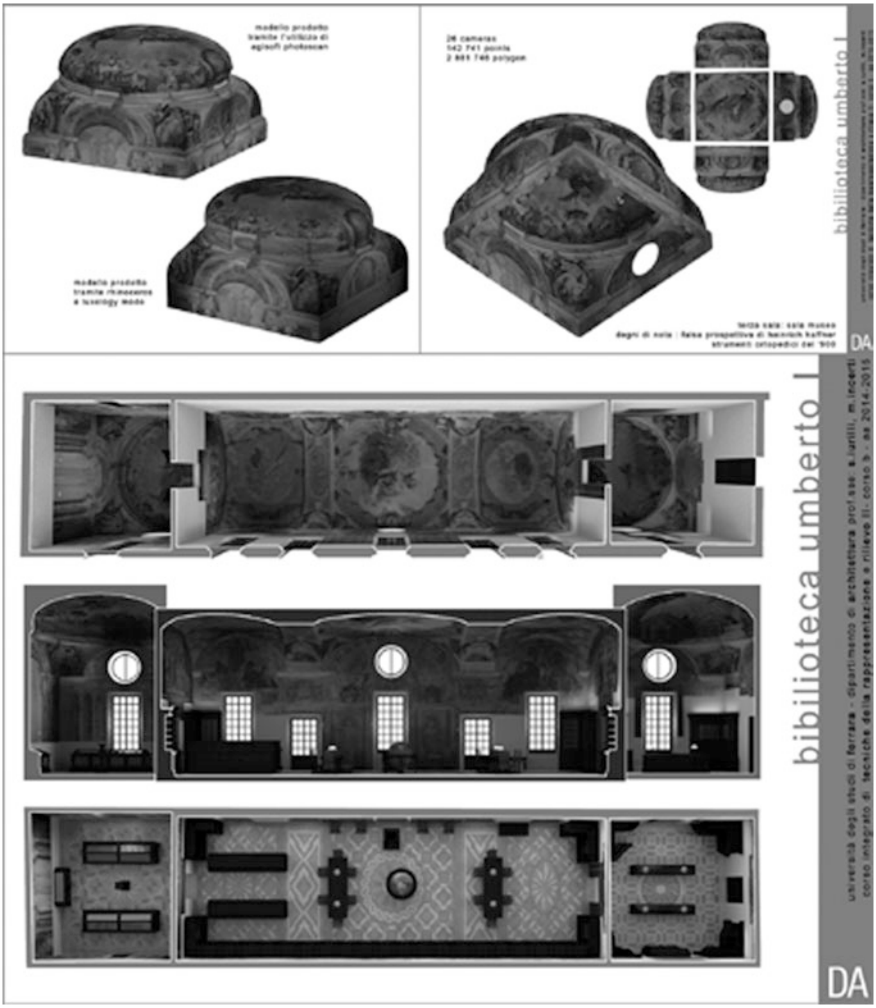

Fig. 2 Elaborate of the Corso Integrato TRA2, AA 2014–15 (Prof. M. Incerti, Prof. S. Iurilli), students: Mattia Bocchini, Andrea Badlands, Luca Cei, Alessio Fragai. *Top left* the texture has been rebuilt with an architectural photomodelling program, *top right* a comparison of the different models, *below* the drawings of the scientific library model

instrument slowness in recording operations certainly makes this phase very challenging. On the other hand, subsequent laborious machining (in terms of both time and hardware) was not necessary. The points detected with the disto leica 3d in “horizontal scan” mode were mounted in a single file that has allowed to students to verify and, subsequently, assemble the direct surveys. “vertical scans” have also been used for verification of measurements and the assembly of the two detected levels. The survey with the Leica 3d disto allowed the documentation the progress of important architectural deformations such as the incline of the long corridor (pointing north) which generates a significant gap between the staircase and the serlian window.

Training for the tools and indirect survey procedures occurs during the second year, with the course of RIL2 integrated with TRA2 (AA 2013–14_2014–15_Prof. M. Incerti, Prof. S. Iurilli, 9 cfu). The input of information technology in the field of surveying instruments and the development of the linked laser technology have initiated a qualitative leap in the acquisition of points in space. It is now possible to combine qualitative data with extreme accurate, pure metric data (Mandelli 2007). More recent tools including digital photogrammetry using specific software join these existing tools and survey methods, which have been in trialed extensively since the late '90s. The approach we have pursued in the teaching of advanced surveying is to propose a critical reflection on the choice of instruments and procedures in relation to the object and purpose of the survey. The proposed exercises, which are applied to the theme previously developed over the course of RIL1 (conducted in accordance with procedures of direct survey) aim to experience the instruments on the field and attempt to solve the problematics encountered during the of integration of data for a digital restitution and their critical reading through digital drawing. Theoretical arguments and exercises include: photography for the architecture, digital architectural photogrammetry, integrated topographic survey, survey with laser scanners, analytic photo rectifying. After brief introductory tutorials, students are called upon to apply tools and procedures illustrated in lectures to their own exam topic, with the aim of instrumentally verifying the validity of the data produced by direct methods and procedures and to increase the level of knowledge of the topic.

In parallel to teaching, a major campaign with laser scanner Faro Focus3D was initiated by faculty for a total of 167 registered scans because of the morphological complexity of the building and the difficult accessibility and visibility of higher elements. This material, a post-production object, was made available to students who wish to supplement their survey with such data (slice of the point cloud and orthophoto of the cloud).

The geometric digital image rectification was functional to the reconstruction of sections of the interior material, while the analysis procedure (with the support of topographical points acquired with the Leica 3d disto) also returned some of the prospective frescos of which the monastery is rich. Digital photogrammetry has been used both for details and for the reconstruction of architectural spaces through three-dimensional textured models as, for example, the frescoed vaults of the Scientific Library (Fig. 2), 1677 by Domenico Maria Canuti and Enrico Haffner (Incerti et al. 2014).

3 Teaching: Digital Representations (S. Iurilli)

As mentioned, the training for techniques and indirect survey procedures occurs in the second year, with the RIL2 course integrated with TRA2. On this course, the student required to carry out a practical test and a theoretical reflection on the three-dimensional representation.

The virtual design allows you to model, transform and deform surfaces, giving shape to the architecture dynamically controlling it in the space in an operational process only apparently free from geometric obligations. It has become indispensable to develop a “geometric conscience” for this virtual representation process, useful to guide the management of the project management and survey. The ability to control the virtual space is developed through a theoretical knowledge of the geometric qualities of the model (understood as discretization of the material forms of the space), as well as the possibilities and tools offered by the various software. The selected application examples aim to encourage the student to develop a critical knowledge and acquire the necessary operational capabilities. The purpose of the models, together with the characteristics of the architectural object represented, justify or suggest the use of an application rather than another according to the specific opportunities and limitations related to the intrinsic structure of the data that it returns.

The theoretical topics and exercises tackled during TRA2 are designed for this purpose and include: solid modelling, modelling with the use of BIM type parametric software, use of NURBS modelers and polygonal modelers and rendering, photo-realistic rendering and not photorealistic rendering, brief overview of animations. Special attention is paid to the possibility of exchanging data between different software, which allows valuable integration between the proposed instruments, and often allows students to solve practical operation that cannot be managed by a single program.

After the lectures and short introductory tutorials, students are called upon to apply examination tools and procedures outlined in class on their own exam topics.

It is important to emphasize that, in order to provide thematic and methodological unity among the courses; all intermediate exercises are designed as a “step” required to reach the final objective. Each exercise is preceded by a tightly targeted lecture (eg morphology and modelling of vaults, even to cover irregular rooms, reading, drawing and modelling of the architectural order), followed by a few hours of laboratory. Here, the teacher accompanies students in the realization of the first part of the assignment, in a sort of live tutorial, which allows to simultaneously learn about tools and techniques and to provide a semi-finished product, useful for the examination. The exercise is normally completed at home and delivered the following week.

For the final exam assignment, a three-dimensional modelling of the architectural object of their survey work (direct and indirect) is required. The choice of software is free, but must be consciously motivated by the student. Given the irregularity and complexity of the historical architecture, the difference between the model and the reconstructed digital material is immediately obvious. However, the purpose of the model is to describe the spatial and material qualities of the architecture and not to rigorously return the metrics. The selection and synthesis of data that the student has to make are therefore functional to the manageability of the model and the scale of representation. The suggested route relies on a process of regularization of the spaces that simplifies the construction of the surface model without compromising the perceptual effectiveness of the subject. It is also necessary to produce a small animation clip in which the real or theoretical path of the observer inside the space is simulated. The space should be remodelled, textured and illuminated.

It is an operation of synthesis, rather complex for second year students. However, the results reported in the first years of trial encourage us to continue on this path.

4 Integrated Teaching: The Question of Data Interoperability (M. Incerti)

Interoperability between different software is certainly one of the central issues of digital drawing, it is therefore necessary to propose timely and simplified paths to students for this problem. An interesting field of experimentation is that of integration in the digital model, reconstructed starting from survey drawings elaborated from data processed using digital photogrammetry. In historical architecture, the presence of elaborate sculptural elements is in fact a widespread, their construction with modelling programs being very expensive and complex.

Figure 3 illustrates the newsstand containing the sacred image of Mary, produced with a photomodelling program, exported in .obj format and loaded in the developed model, starting from regularized survey data with the programs Rhinoceros The Foundry Modo.

Figure 2 compares the textured model of one of the Scientific Library vaults of a digital photomodelling program and the 3d modelling program Rhinoceros and The Foundry Modo. Some flaws are obvious in the implementation of the texture on certain surfaces of the second example due to the students' inexperience with the complex instruments for UV mapping in the manual processing of the textured surfaces.

5 Research: From Surveys to Multimedia Communication (M. Incerti)

The research team is conducting several experiments on new multimedia communication modes, interactive and not, based on virtual models, edutainment tool, for the fruition of artefacts and cultural sites (Incerti and Iurilli 2014). Current trends, initially relevant to scientific facilities, see the gradual transformation of the museum

Fig. 3 Drawings by the Corso Integrato TRA2, AA 2013–14 (Prof. M. Incerti, Prof. S. Iurilli), Students: Elena Moroni, Richard Lee Peragine, Valerio Recchioni, Emanuele Sabbatani. Model and render of the San Michele in Bosco monumental staircase (Arch. Pietro Fiorini, 1588)

from a place of conservation and management of tangible or intangible heritage, into proactive agents in the provision of accessible culture to mass audiences, thanks to the extended and multiple uses of technology and new interaction paradigms. The various forms of interactivity and immersion in use today increasingly aim at education and research, but also prioritise the enjoyment and enhancement of the visitor experience (Torres et al. 2015). The specificity and the potential of digital representation doubtlessly concentrates on the design disciplines featured in the communication of complex and stratified scientific and iconographic content.

The purpose of the case studies we have trialed so far is to put the skills of surveyors, historians and experts of multimedia communication into play to test the potential of digital products such as non-formal teaching tools, allowing fruition of content. If it is more complex and layered it will also allow more engaging, efficient, intuitive and customizable interaction.

The research project of San Michele in Bosco provides, starting from the survey data, the execution of digital models and virtual reconstructions able to provide information about its history and its architectural layout. A browsable multimedia product of the octagonal cloister of the Carracci was also created.

The octagonal cloister of San Michele in Bosco is situated in the area of the pre-existing Renaissance cloister. It was designed by the Bologna born architect

Pietro Fiorini and construction began in 1602 (Figs. 5, 6 and 7). The space is better known as the "Carracci cloister" because of the famous painting by Ludovico Carracci (assisted by artists of his school) and Guido Reni. The visual story unfolds in 37 sections divided into the two cycles of St. Benedict (21 episodes) and Santa Cecilia (16 episodes). The organization of the decorative score derives from the projection of the serlian window of the lesser octagon onto the outer perimeter. The most significant scenes of St. Benedict's life are placed in the central space (wider and higher because of the presence of the cross vault) in all areas except those occupied by monumental portals leading to the upper church, the Chiostro del Pino and the refectory. The five main scenes and the three portals are always flanked by two minor episodes from the life of St. Benedict, whose height is lower because it is limited by the frame of the barrel vault. In the eight corners the stories of Santa Cecilia are isolated, flanked two by two. The compositional rhythm is thus: Cecilia, benedict, Benedict, benedict, Cecilia, (Campanini 1996, 186) according to a spatial distribution that requires various station points and paths for the viewer to follow the narrative of each cycle (Figs. 5 and 6).

Fig. 4 Drawings by Corso Integrato TRA2, AA 2013–14 (Prof. M. Incerti, Prof. S. Iurilli), students: Alessia Marie Cova, Elisa Lipparini, Giovanni Loche, Francesca Marchetti. Model rendered by the Putti study of San Michele in Bosco

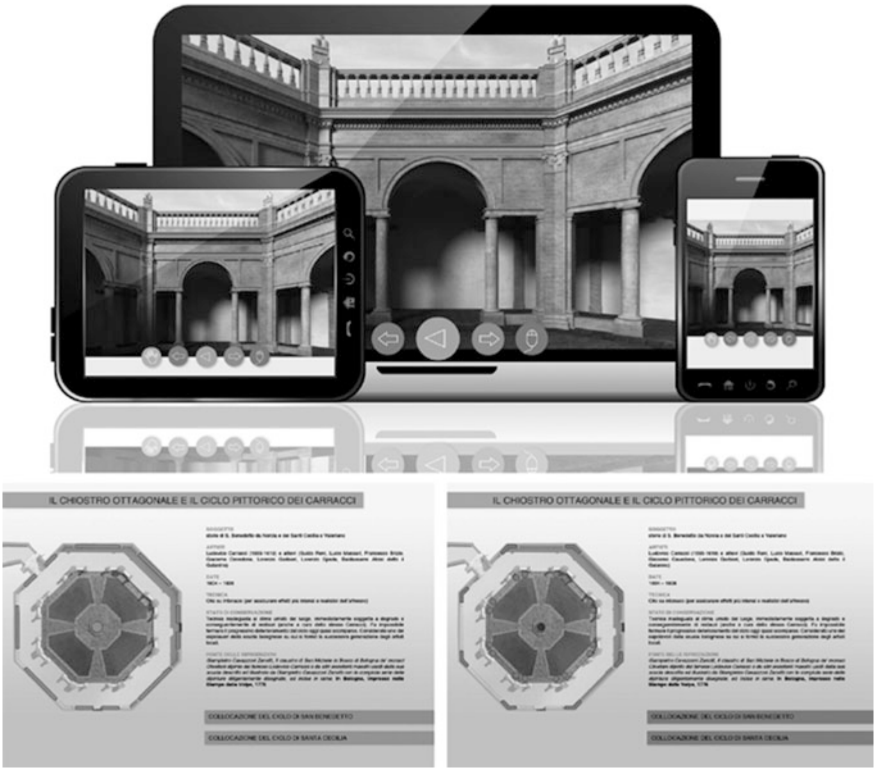

Fig. 5 Multimedia product interface created on the octagonal cloister and pictorial cycle of the Carracci by the research group. *Below* are the two schedule regarding the location of the two distinct cycles of St Cecilia and St Benedetto which require different view points for their appreciation. The information presented includes: object, episode, artist, date, textual source, technique, state of conservation, source of the reproductions and iconographic comparisons. Through tags, one can deepen their knowledge of independent fields such as author biography

Because of moisture in the masonry and the construction technique used (oil on plaster) the stories immediately suffered a sharp decline that quickly led to their gradual disappearance. To preserve this treasure of traditional city art from oblivion, two different survey campaigns were carried out, published in two largesize volumes (Malvasia 1694; Cavazzoni Zanotti 1776). From the incisions, one can only guess the significance of the construction perspective, expertly used to visually expand and break through the real space of the closed claustrum. The research experience has thus seeked to experience the potential of the virtual reconstruction to evoke, at least in part, the perception of the original space, syncretically defined by architectural form and painted perspective space. The chosen approach follows the philosophy of complete restoration, where the addition of accessories is implemented according to the criterion of recognisability (Figs. 6 and 7).

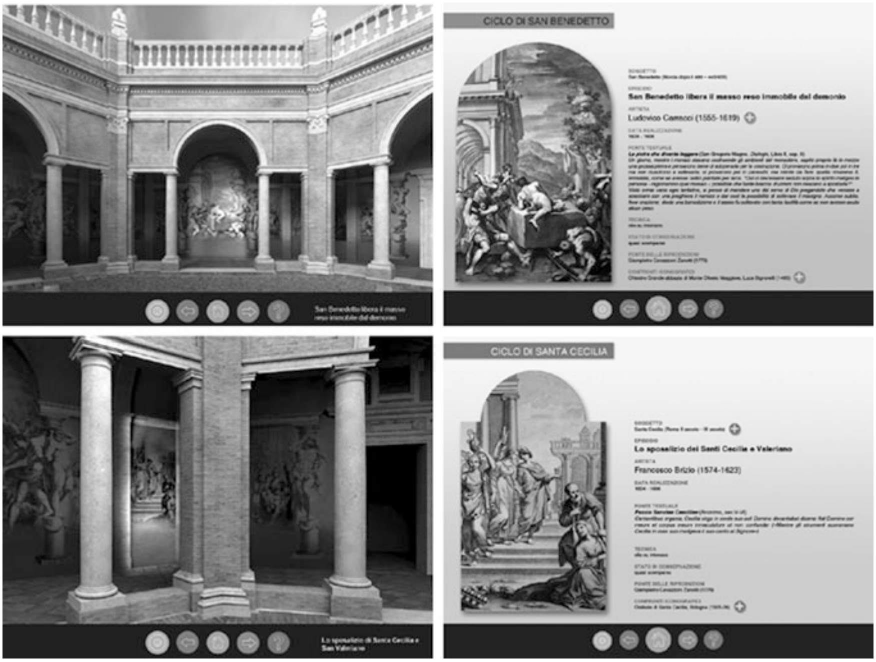

Fig. 6 Exploration of the model of the cloister and an example of the descriptive information on two of the hagiographyc scenes

6 Research: The Interactive Model of the Carracci Cloister (S. Iurilli)

To effectively convey the space of the cloister, a mathematical surface a model was created as a basis for surfaces, describing the ideal geometry of the object and ignoring the irregularities found in the relief. The model, comprising only essential architectural elements, was then converted into a numerical mesh model to which greater detail has been conferred with the addition of moulded geometries and photographic textures derived from orthophotos. On this basis, an exploratory promenade through the ring-shaped porch was created to recreate the object's spatial perception as in the time of its realization.

The thematic and cognitive deepening happens on the interactive model according to different levels of reading, ranging from general to specific. The general approach to the two cycles of paintings is divided between the two hagiographic objects (St. Benedict and St. Cecilia) from the beginning, with the identification of the different preferential viewing points for the correct view of the respective sectors.

Clicking directly on the representations with tags allow access to a second level of reading, a card structured with texts and images containing information on the

Fig. 7 Virtual reconstruction of the frescoes in the San Michele in Bosco octagonal cloister (Arch. Pietro Fiorini, 1602). The *top left* shows an elaborate of the Corso Integrato TRA2, AA 2013–14 (Prof. M. Incerti, Prof. S. Iurilli), students: Moretti Barbara, Neri Michela, Zattoni Alessandra; the other elaborates have been extracted from the multimedia product supervised by the research group

subject, episode, artist, date of creation, source text, technique, condition of conservation, source of the reproductions and iconographic comparisons. It is also possible to access subsequent levels of reading on the author or the other items on the card (Figs. 6 and 7).

7 The Virtuous Link Between Teaching and Research (S. Iurilli)

As has been stated above, the proposed teaching experience is inspired by the logic of the triangle: education research innovation. To achieve effective integration, these three aspects should not be considered as compartments in their own right, but as parts of a single growth process simultaneously involving teachers and students.

In this sense, focusing the teaching—and therefore the cultural evolution of students—on the same research themes is extremely useful and performative for both parties. Of course, the benefits do not include the indiscriminate use of student work, but derive from sharing a deep knowledge of the history and morphology of the places studied, gained in the field through a mutual exchange prolonged in time. The research products, while sharing the same bases with exercises for teaching purposes, remain the result of specific processing by teachers, controlled and executed with a higher scientific and technical background level.

In this sense, it is very useful for the process of knowledge development to know possible errors that are frequently encountered, because of naivety or lack of dexterity with the graphic instruments.

The first aspect to highlight is the ability to discern the degree of detail to be given to architectural and sculptural elements that, as part of a comprehensive architectural description, have different relevance and meaning. They can also heavily condition its use in relation to the construction of the model chosen: for example, a roof made of tiles and shingles (very demanding in terms of model weight) (very demanding in terms of the model weight) does not have the same importance as cornices and moldings which instead should be given greater attention. With time, experience shows where to focus of hardware and software resource efforts to optimize the model according to intended use.

The choice of texture (in this case especially for the floors and the finishing of the walls) is another area where the experience and sensitivity of the designer can make a difference. In the images below, we compared textures of masonry by students, with that produced by the research team. This was developed starting from orthophotos and therefore more consistent in tone, compositional geometry and chiaroscuro (Fig. 7). Students also had access to the historical-document material of the research team in order to experience a virtual reconstruction of illusory spaces that have now disappeared. In this field, the skills acquired with practice allow one to apply textures with greater expertise elaborate, softening edges with a gradient effect to gently link the document image to the portions of the walls of which we do not possess textural information.

8 Conclusions

The teaching experience described above is distinguished, in our opinion, as its logic is inspired by the knowledge triangle (education research innovation) and for the critical approach to learning of the software and advanced survey techniques. Our training courses are often limited to the teaching of a single software, thus following the classic approach of professional payed training courses. We are aware that the number of hours reserved for us strongly influences the possibility of consolidation of the trials conducted; however, we believe the building of a mind-set is more important than the number of software commands known. It is clear, however, that in the future our schools will gradually reflect the need to give more space to the DISEGNO disciplines to allow our young professionals to juggle the multiple opportunities of digital technologies (Figs. 8 and 9).

Fig. 8 Reconstructions of the ex steam room within the San Michele in Bosco complex. Drawings by the Corso Integrato TRA2, AA 2014-15 (Prof. M. Incerti, Prof. S. Iurilli), students: Stefano Caposciutti, Davide D'Ambrosio, Tommaso Finessi, Nello Verrocchi

Fig. 9 Dawings by the Corso Integrato TRA2, AA 2014-15 (Prof. M. Incerti, Prof. S. Iurilli), students: Mattia Bocchini, Andrea Calanchi, Luca Cei, Alessio Fragai. Render of the Scientific Library

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Graphic Analysis Between Teaching and Research. Mario Ridolfi Unbuilt

Virginia Lorello and Francesco Maggio

Abstract The graphic analysis in *absentia*, moving between thought and work, tries to track down, through digital surveys, a consistent path of design process. For many years now, the digital has changed the communication architecture processes that have always been areas of critics and representation. Architecture, indeed, can be told with texts, and new and unreleased representations wandering the sites of fruitful interaction between theoretical production and digital processing. The purpose of this study is to tell two projects, through unpublished images, about a little-known Ridolfi, through the close relationship between history, drawing and project.

Keywords Graphic analysis · Italian rationalism · Modeling

1 Introduction

The graphic analysis of unrealized works requires a critical approach towards the representation itself. The virtual reconstruction of an object, indeed, puts us to the inevitable question of its recognition and relationship with reality.

To make a recognizable object, you first need to know it: tracking down the ideas that conceived it, retracing its compositional process, revealing its matters. Its transmission and therefore recognizability will be allow depending on the language used.

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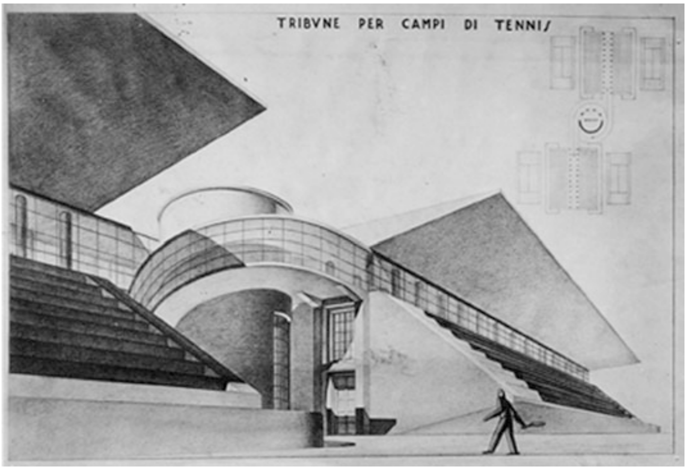

Fig. 1 Tribune for tennis courts project

In this regard, the question that arises Tomàs Maldonado in *Real and Virtual* regards the reliability of computer drawing both learning tool and as a means of representation, instead of real models. A key issue that relates to the theory, increasingly felt, of progressive and inevitable dematerialization of our reality.

Contemporary society is closely linked to the use of virtual images, from the ludic to the technological and scientific field. This approach tends to become more and more feverish and very often takes the form of an escape from everyday life. But do these evanescent elements, often aimed at a realistic reproduction of the object, allow a real cognitive approach? Or are they only a distancing from the perception of material elements?

Assuming that the relationship between man and sensible experience exists because ingrained in it, the author highlights how the powerful but also little explored and exploited computer tool, allows several advantages both from the quantity and quality point of view.

Their malleable and manipulable characteristic enables "a richer and controlled interaction between user and model". Their syncretic characteristic, comprising the most varied types of modeling which until now have been explored, allows many more possibilities in a shorter time. "Three techniques that until recently separately were used: replication (emulation), simulation and mathematical formalization" (Maldonado 1992, 68).

The architect is responsible, as 'viewer' since the Renaissance days, to use consciously the *model* tool and to fully exploit its considerable operational freedoms.

The architectural representation must therefore tend to enrich the real experience, as it has always been done by producing *maquettes*, and enjoy a continuous exchange of beneficial information to the research.

Starting from these considerations graphical analysis and modeling of two new Mario Ridolfi projects took shape, the project for Tribune for tennis courts in 1928 and the project, in 1929 of a marine colony for 300 children in Castel Fusano, his dissertation (Fig. 1).[1]

2 Tribune for Tennis Courts Project

In 1928, at the *Exhibition of Italian Rationalist Architecture*, Mario Ridolfi presented five of his works some of which little known: a project for tennis courts, the most well-known, Tower for restaurants, the project for a hotel and projects of flower shops in piazza Monte d'Oro in Rome with offices building in Piazza di Spagna.

His participation, along with that of other architects of the Roman school, raised many perplexities; Carlo Enrico Rava, a member of the Group 7, indeed, a few days before the inauguration of the Exhibition, sent to the organizer of the exhibition, Gaetano Minnucci, a letter containing harsh critics towards mostly Roman architects, who did not present rationalists characters architectures. Among the names in the letter appeared Ridolfi too.

The table presented during the Exposition contained only a perspective and a plan diagram and there was not shown the location of the project. This absence of localization, probably derives from the fact that it could be just an example, of a design scheme to be taken as a model for similar spatial situations.

The system proposed by Ridolfi consists of four tribunes for tennis courts, realized with roofs and steps in reinforced concrete, mirrored between them so as to allow two tribunes to have in common a glazed passageway that wraps around a central element, a cylinder made of concrete, real fulcrum of the project.

The contrast between the elements generated by the project (rigid lines of tribunes and sinuosity of ribbon) is evident in the contrast between the continuity of fully glazed ribbon and the rigidity of cylinder and tribunes. The only entrance distinguishable in perspective view is access to one of the tribunes, while the cylinder and the ribbon's entrances are not traceable.

The graphic analysis started from the dimensioning of plan elements as in the table there are no stairs or other graphical annotations. The tennis courts, as standard item, have allowed the construction of the actual dimensions of the project and a partial orientation as tennis playgrounds should be oriented north-south; the floor plan has been redrawn from the identification of a possible modular grid of the composition process.

The analysis of perspective representation has not been sufficient to determine the heights, in fact produced not a few ambiguities: some elements have been falsified and others were omitted. It took several graphics assumptions and research

[1]The paragraph about Marine Colony project is written by Vincenza Garofalo; the paragraphs Tribune for tennis courts project is written by Francesco Maggio with Introduction and Conclusion; the representations Virginia Lorello.

of different analogues formal references to solve some nodes that have not represented by the architect, perhaps because unresolved.

First of all, the lack of a ground floor plan. From this one it would be possible to obtain information about spaces underneath the tribunes, on the end of the cylinder and glazed corridor. There are no details on northsouth elevations nor on the west (or east).

The overall height of the tribunes has been determined by comparing the regulations for sports facilities with the information found from the perspective analysis. According to the Architect's handbook by Daniel Donghi, steps had to measure between 45 and 50 cm. Next examples arising after publication of this project indicated instead a height of 60 cm, but neither of these cases has been able to consider because the end result would have returned a ribbon height too low (between 1.40 and 1.70 m). Establishing not modify the plan floor proposed by Ridolfi (because the number of steps in plan corresponds to that of perspective) and preserving the proportions suggested by this one, the restitution which ensured a passage inside the ribbon of at least 2.70 m determines steps' height of 80 cm.

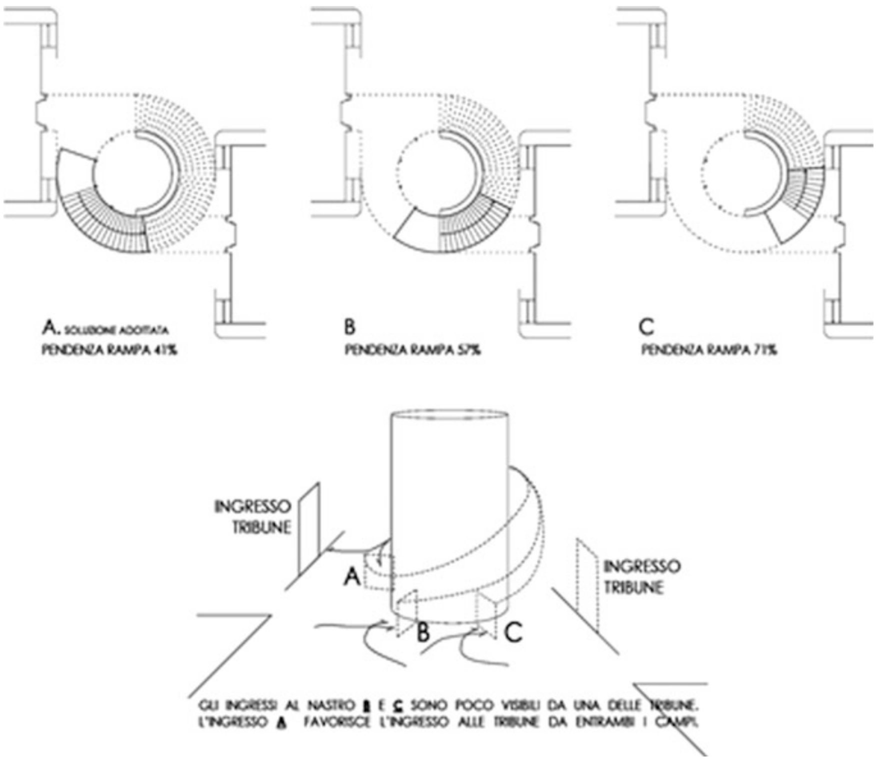

Fig. 2 Graphical analysis of the main body cylindrical

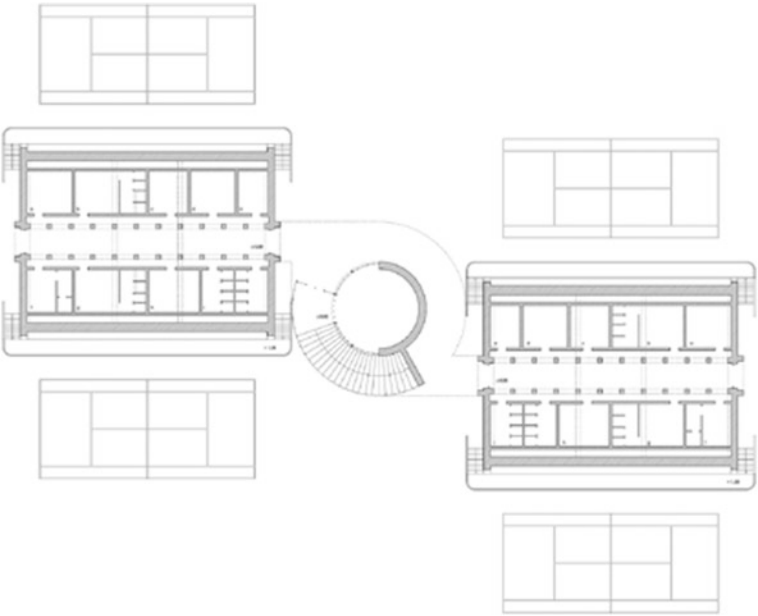

Fig. 3 Plan

Since the height was excessive, it was assumed that among steps they were present stairs and were separately applied to sittings.

The identification of the ribbon's entrance and the cylinder's closure have been obtained by reference to a Pier Luigi Nervi project: the project for the *Palazzo dell'acqua e della Luce* (1940) produced for E42. Although next to the 1st Exhibition it is actually an appropriate reference to the close link between the two architects, coming to sign the adhesion to the APAO organic movement. The decision to place the galleries' entrance from the ribbon-element rather than from the cylinder was considered the most suitable, as well as to endow it with a graded ramp although it was not highlighted in the plan layout (Figs. 2 and 3).

As regards the determination of the end point, reference was made to the criteria of grade, visibility and ease of access to the tribunes.

The rigorous symmetry and several references to lera's sports facilities contributed to the definition of the drawing of the ground floor inside the body of the tribunes.

Near the central area, designated for buffet, it was decided to allocate spaces to serve the public and buffet itself. The other entrance is attributable to the athletes and heads of the field.

To overcome problems of brightness, the interior spaces were considered as boxes without closing, almost like the exhibition halls. The elevations which are not included in the perspective are considered to be identical to the one drawn, under the principles of symmetry and brightness (Figs. 4 and 5).

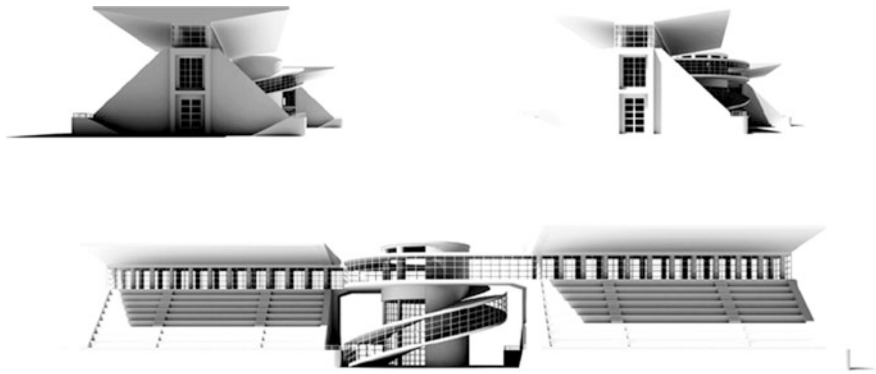

Fig. 4 Elevations and perspective

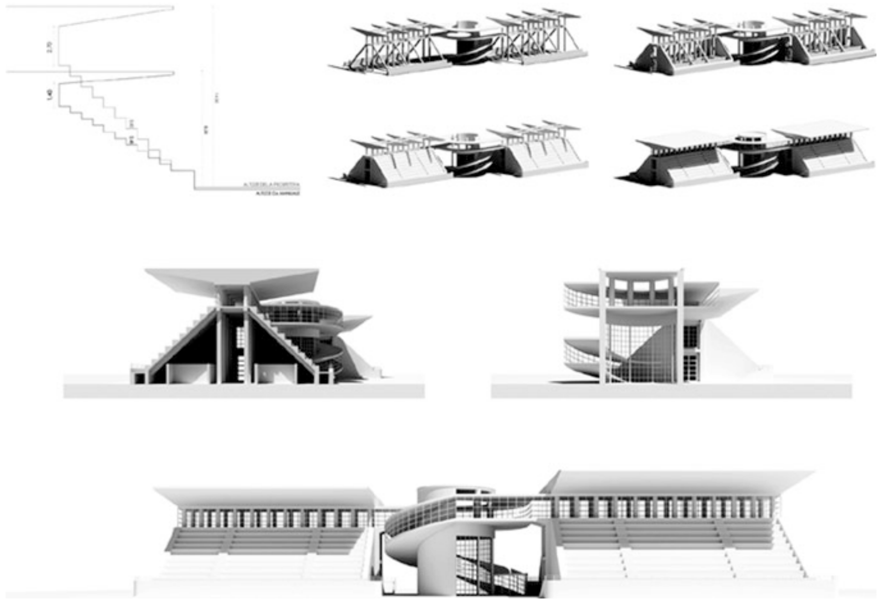

Fig. 5 Schemes, perspective sections and perspective

3 Marine Colony Project

Ridolfi graduated at the Royal School of Architecture in Rome with 105/110 and presented the Marine Colony for 300 children in Castel Fusano (Rome) as a dissertation project. The School demonstrates that it appreciated the project by filling it in a collection of the best works produced by the school in the first decade.

Two years later, in 1931, the project was exhibited at the *II Exhibition of Italian Rationalist Architecture* with the building for 24 apartments, kindergarten in Giglio Island and, with Adalberto Libera, the economic houses in Tor Quinto.

The Second Exhibition was held in the private Roman gallery of Pietro Maria Bardi, in Via Veneto, and unlike the first one, Ridolfi obtained the consent of the Committee, in particular by Carlo Enrico Rava, the same who in 1928 had apostrophized Gaetano Minnucci for the presence of the architect among rationalists.

The colony is a totally new type of building for those years. It was introduced by the government to provide for the health and culture of underserved children, thereby ensuring rearing strong and impregnated with fascist culture young people. The organization that was involved in the foundation and organization of the colonies was the *ONB*, *Opera Nazionale Balilla*, and provided also to divide young people, from 8 to 18 years old, in several categories.

In the thirties many colonies were built throughout Italy; models to refer to the architectural composition were those of marine hospice, school and clinic of the late nineteenth century. The designers had in this way a background highly customizable and the colony was a perfect field for experimenting with new languages and feel part of the construction of the future society.

A patriotic propaganda and collectivist ideology owned to each design choice and even though it was a fertile ground for research, there were still precise indications of composition dictated by ethical and political principles of fascism.

Hygiene and disease prevention strongly influence the delimitation of areas that need to be bright and airy, providing also places of isolation for those infected ones. Children should enjoy a natural setting, away from urban settlements and isolated from any other type of contact with the adult world. The only adults allowed inside the facility were the teachers and staff, usually placed at the edge not to promote contact with balilla.

The colony was to provide large spaces for sports and outdoor play to temper the body and the spirit, divide the activities of males than females, include dormitories with 20/30 beds and places for worship and eating meals. Discipline, obedience and hierarchy were guaranteed by the adult supervision of each space, resulting in lack of individual spaces or places of personal retreat.

In addition to architecture also clothing, daily activities and natural cures (such as light therapy and thalassotherapy) followed precise regime's precepts.

The Marine Colony Marina in Castel Fusano experiences compositions solutions with reference to the most different types of handbook buildings: hospitals, churches, colonial cities, monasteries, beaches, prisons, small hotels and schools. There they are respected suggestions prescribed by the party, but it is actually a means of testing of the new language.

Bruno Zevi wrote in 1964: "Ridolfi graduated […] with the project for a marine colony in Castel Fusano that was politically different from the stylistic addresses of the school conducted by Gustavo Giovannoni, and corruption of the twentieth century of 'modernized classic', maximum of freedom bestowed to the students. The works of Ridolfi claimed a break line. They could not reject it because of its extraordinary inventive skills, but ever since they marked him among the

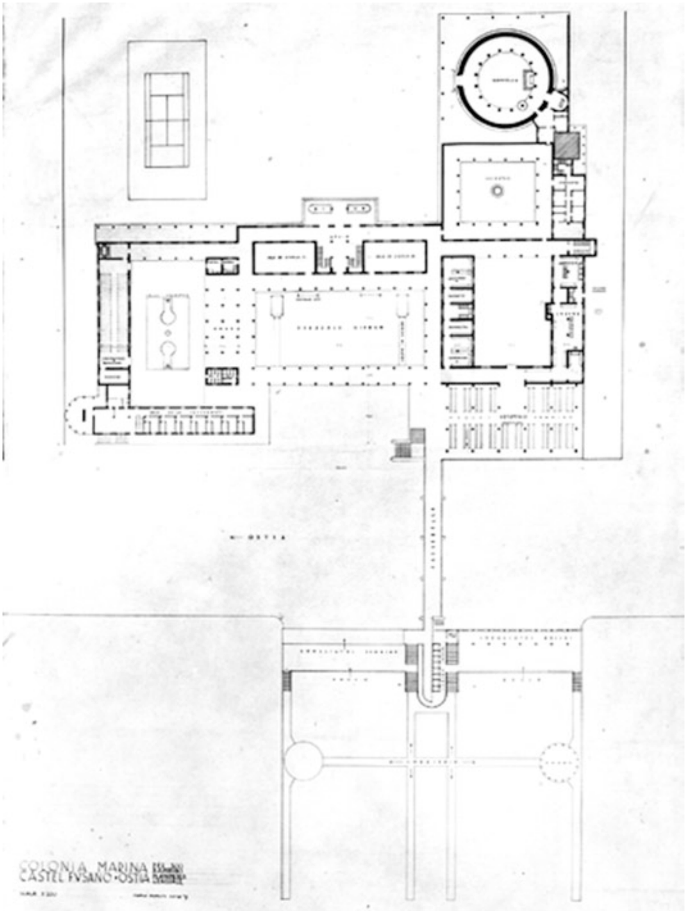

Fig. 6 Plan

undesirables. Indeed, the following year, to win a scholarship of *pensionato d'architettura*, he was forced to bend drawing up a *novecento*" (Brunetti 1998, 22).

Related to the Ridolfi project are present, obtained from the Ridolfi archive fund, six drawings, created in tempera, pencil and ink, the floor plan in scale of 1: 200 and different perspective views some of which lost. In the magazine *Controspazio, Architecture Mario Ridolfi/1*, have been instead recovered a plan with a scale of 1:100 on the Church and convent and two perspectives, while in an issue of *Architettura e Arti Decorative* of 1930, into an article regarding to the graduation works of the School of Architecture of Rome, other images have been traced that have helped to enrich the knowledge of information project of the Colony (Fig. 6).

In this magazine it was found the following text describing the project, among other thesis produced in the Royal School of Architecture: "The architect Mario Ridolfi, with stylistic trends radically modern, but not for this reason dry or cold, even lives of clear sensitivity, chose a current topic, free of reminiscences. A marine colony in Castel Fusano, that, as can be seen from the floor plan unit of the whole, he has precisely located far away about 2 km, south of Ostia Mare. The colony hosts 300 children, half male and half female, and consists of a total of 6 reinforced concrete buildings. The shaped like a double U major building, has the main buildings facing the sea and mutually spaced so that the sun in the hours of awakening (7 h) invades the beds of the lower dormitories. On the ground floor of this building there are: the common refectory, with the attached services and washbasins. This environment is shaped like a huge roof, and has fully open sides and equipped with colored tarpaulin tents, for the defense from the sun; showers, divided by gender; the laundry; the ironing; a meeting conference and projections space; the indoor playground. Instead recreation takes place in the open courtyards to the sea and placed so that you can practice the playing of the basketball, long and high jump, arms gymnastics, etc. In the first and second floors there are dormitories (containing not more than 27 beds) course sharply divided by sexes; toilets, and rooms for the attendants (two each dormitory). The dormitories are sized according to the current regulation on hospitals and nursing homes. Attached to the main building there is the teachers' house, which has the character of a small hotel on the sea with 14 beds, equipped with all facilities. You can find accommodation for 12 teachers (one every 25 children) effective, a spare one and Dr. employed to care for sick children. The rooms are divided into two floors each accompanied by an adequate bathroom and a small passage for the cabinet. The beach club is connected to the main building with a walkway passing over the *Viale della Marina di Roma*. It is equipped with a large separate dressing rooms, cabins for teachers and attendants, and complemented by large kiosks for shade. The cylindrical shape church is structurally composed of a main drum in masonry and a concentric series of concrete columns, internal to it. The roof, resting on the mentioned supports, is constituted by a slab in the inner part to the columns and it is decorated, while in the remaining outer circular ring, the slab is replaced by a lantern that allows light to rain along the top and the cylindrical wall. A stone white altar and a wooden pulpit decorate the interior. The church is completed by a small chapel for the preservation of the SS. Sacramento and a sacristy with room for storage of vestments. The bell tower attached to the church is in clear contradiction of form and color with this one. In the small convent with adjoining cloister they are placed five nuns involved in the care of children lying in the infirmary. The house of the Director, isolated from the Colony, may be the type of a house by the sea of exclusive summer stay for small family (Architettura e Arti Decorative, 2, 1930, 76–79) (Fig. 7).

The information not present in recovered drawings mainly concern: the exact location of the colony and the house of the director; spaces on the upper floors or the mezzanine, the whole complex of dormitories (of which there is only partial information) and the complex of the infirmary; elevations of the bathhouse and the connecting bridge; all openings on the ground floor, except for the main façade and the house of teachers, development of the bell tower.

The location of the project, expected far 2 km from the center of Ostia near the complex of Castel Fusano, is not clearly legible.

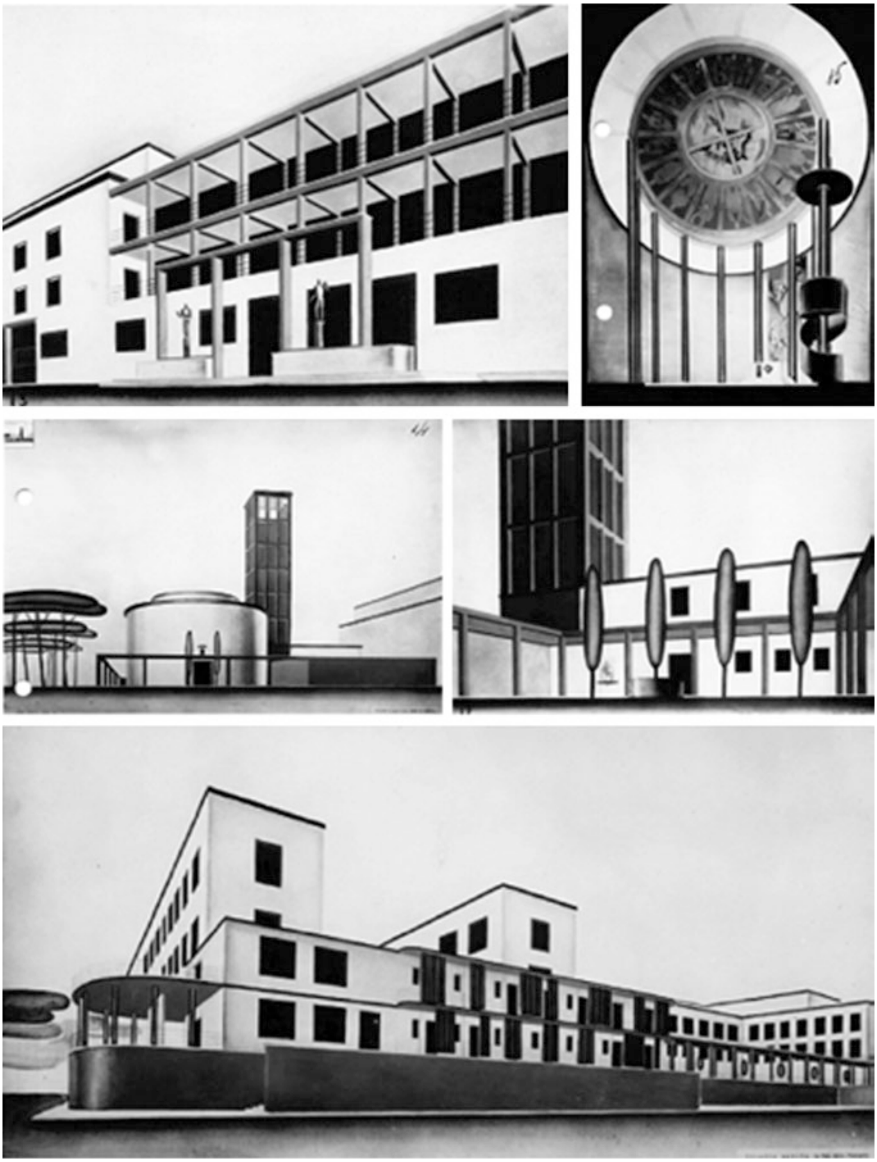

Fig. 7 Perspectives

Ostia had already equipped with the Colonia Vittorio Emanuele III in 1927 (enlargement of Vincenzo Fasolo in the colony of 1916 by Marcello Piacentini) that had been built following the plan of 1916 drawn up by the *Associazione fra i Cultori di Architettura*.

Fig. 8 Axonometry

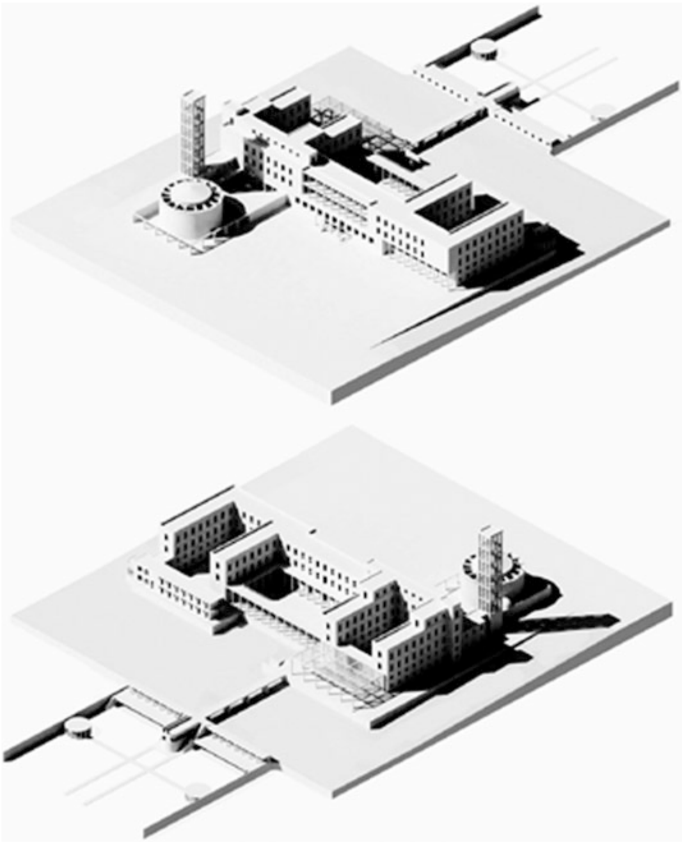

Fig. 9 Perspective

One could speculate that Ridolfi, following the opening of the Via del Mare in 1928, thought about an enlargement of the city and the need for a new colony. Indeed, apart from the character of the city-garden established in 1916, in 1925 the Master Plan for Ostia Mare provided for the opening of new roads, the construction

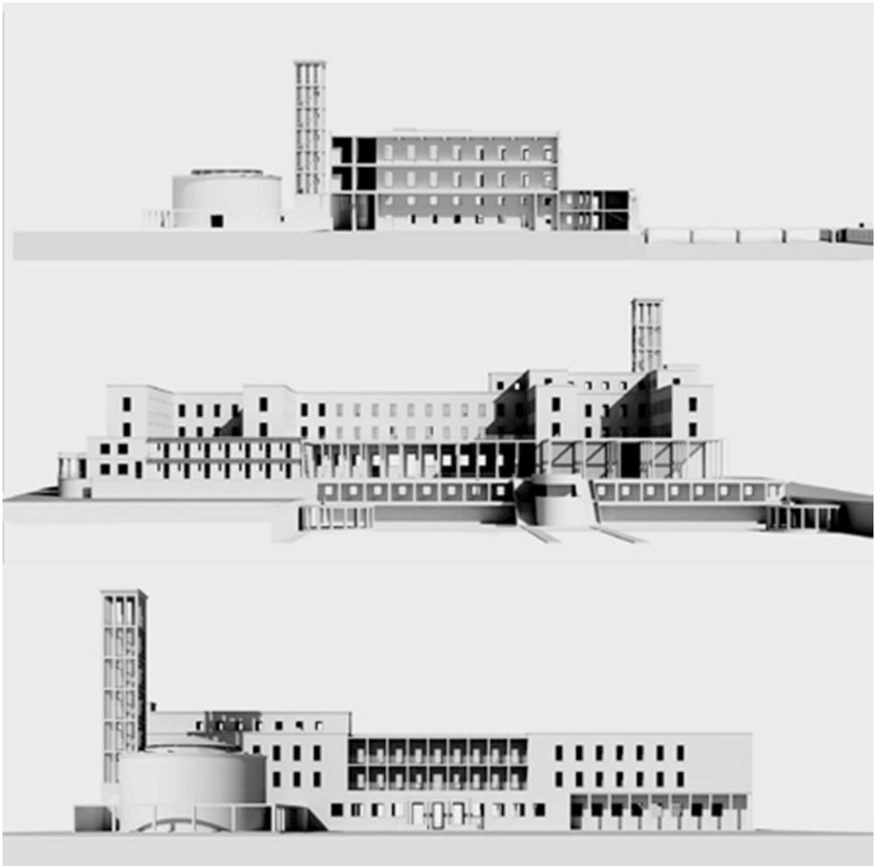

Fig. 10 Perspective section and perspectives

of a new port, industrial areas, areas for sports and school. Neither the type buildings nor the intended use to be attributed to the different areas had been specified. To confirm these predictions in 1933 a road linked the *Lido di Ostia* with the *Pineta di Castel Fusano*.

Considering as references the types from handbook or colonies built in the same period, it has been suggested the placement of staff in the mezzanine floor, mirroring of dormitories on the upper floors and decision to place in the volumes of the terraces of the top floor infirmary (for isolation).

Elevations of bathhouse and the openings on the ground floors have been defined from elements already known of the colony: the repetition is considered an added value to the design, especially the severity of the children's colonies.

The tower is a recurring element in the fascist architecture, not only in the colonies for children but also in the fascist colonies, in villages and new foundation cities.

Numerous examples have been able to confirm the general preference for a system with four ramps of stairs.

From analysis of the perspective and plan elements revealed inconsistencies in the main elevation and in the section of the Church.

4 Conclusions

The production of Mario Ridolfi previous to the APAO adhesion deviates greatly from the next, although there are reasons and ideas that come back over time.

The analysis of these two works of the competition was able to show how we can find spatial personal ideas, formal inventions applied to architectural concepts that go beyond the types from handbook inherent in the architect. There are immediate connections between the church of Colonia Marina in Castel Fusano and the Circular Church for the Diocese of Messina. It is the same language that binds the *Tribune for tennis courts* of the early period with the *Sede del Dopolavoro* in collaboration with Frankl (Figs. 8, 9 and 10).

His personal way of perceiving and see architecture in this first phase is very consistent, as full of experiments. His approach to design follows spatial and precise logics, not the fruit of chance or only the influence of the moment.

As this first experience is less refined and devoted to detail than the second one, as well as to constitute a body of knowledge for the architect, testified in an emblematic way the situation of Italian architecture between the two wars. More than any other, it is readable in him the crisis of the Italian modern movement, the eclecticism of taste, the desire to be in continuity with the tradition while straining all efforts in searching for renovation. It is ingrained in him the research of sharp contrast of light and shadow, the preference of empty respect to the void and attention to the plasticity. The analysis of his architecture is enough to understand why our rationalism was not European mold.

Nevertheless, his contribution was important particularly in the field of representation: not only with regard to the techniques which have made a real school, but especially for the way to use the drawing as resolute means of expression.

Ridolfi did not follow the way down normative languages and precepts from handbook regardless of the graphic work who was preparing to produce.

His way of representation is an active and creative approach to the design and demonstrates, through the revision *in fieri* of his own thought, how important is during the production phase to continue to think about the project and see it.

Representation is not a mechanical activity of reproduction, it is not the last activity of the composition process: it is an integral part of the project as much as the preliminary studies.

The drawing for Mario Ridolfi is a way to understand the architecture and, as would say Maldonado, a tool to enrich the real experience.

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Author Biographies

V. Lorello is a registered architect at Ordine degli Architetti di Milano, Italy. She graduated from the University of Palermo in 2013 with a thesis on the public unbuilt architectures of Mario Ridolfi. In 2014 she worked in Eindhoven, the Netherlands, for UArchitechts. Later she started important collaborations with architectural firms dedicated to the world of architectural and product design research, such as Fabio Novembre and Scandurra Studio in Milan. Since 2017 she has been a member of the European Commission as an expert evaluator of innovative projects for the EIC (European Innovation Council), within the fields of architecture, art and design. In 2018 she opened her personal studio in Milan.

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Teaching to See

Clara Eugenia Maestre Galindo

Abstract This paper is a proposal to revisit some of the many opinions of our masters on learning in order to reconsider our present time. Tertiary education, is being convulsed by numerous changes—in academic programs, contents, a strong emergence of bilingualism, etc.—immersed within a proliferation of resources—communication, information access and even our own technology in the field of graphic design—has caused a very obvious decrease in the numbers of students in architecture. As we face other new coming challenges and it will be of great help to look back and recover the experience of our own learning to put it at the service of the future architects.

Keywords Teacher · Change · Honesty

Around 1498, Leonardo Da Vinci oriented his apprentices of painting affirming the following: "We know for sure that vision is one of the most rapid options that exist, and at once, we see infinite forms, although we can know but one thing at a time (…) and, remember that you must first acquire diligence, rather than speed." (1983, 354). Although he continued his sound advice directed to acquiring speed, it was not quite clear as how to obtain diligence, or prior to that, how to learn to see.[1]

If we think about current teaching, convulsive with numerous changes—study plans, contents, strong irruption of bilingualism, etc.—immersed in proliferation of the media-in communication, in the access to information and even in the same technical media inside the field of graphic expression—we observe that, in addition, one is confronted with a more evident diminution of the student body in Architecture. Let us take advantage of these vicissitudes and transform them into opportunity. Reduced groups of students will permit the professor a closer attention to teach how to *see* better. We find ourselves in front of a *new* challenge, for which

[1]Translation: Linda Hamalainen.

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it would be very helpful to look back, recuperate the experience of our own learning, and put it to service in future learning.

This article attempts to revisit some of the multiple reflections on teaching which some of our masters have proposed before, and to observe the manner in which they can be applied at the present moment. Le Corbusier, Arne Jacobsen, John Berger, Álvaro Siza and Norman Foster, among many others, have gathered the importance of knowing how to see in many writings and interviews. Siza emphasizes: "*The exercise of observation is a priority for the architect. The more we observe, in effect, the clearer the essence of the object surges. And this will be consolidated as a vague knowledge, instinctive.*" ([1997] 2003).

"*What do you see when you take a walk?*", asked Le Corbusier at the end of his article "If I had to teach them architecture", published in the magazine "*Architectural Design*" in 1957. In spite of having been written twenty-five years before, it hasn't lost an apex of validity even today. On introducing the word "*a walk*", Le Corbusier leads us to his well-known "*Promenade architectural*," which allowed one to discover the essence of a building. As he liked to say, "*Architecture is walked, is travelled, and is in no way, as certain teachings, this totally graphic illusion organized around a central abstract point that claims to be man.*" (Le Corbusier [1957] 2003, 32).

It is evident that when the student of Architecture first arrives at the university, he experiences a transformation. He discovers a new and different world from that which he had seen until then, without stopping to think that it is not his world that has changed, but his manner of seeing it. He begins to see, and almost without realizing, to question. "*It is seeing once again as if it was for the first time, but without distaining what has been learned along the road of experience and life*." Alfonso Armada explained it this way in the prologue of "Mirar" by John Berger (2001, 164), expressed by Rilke many years before: "*It is not sufficient either, to have memories. One must know how to forget them when they are so numerous, and have the patience to wait until they return*." ([1910] 2000, 19). Siza comments in this respect that "*we learn excessively*: *That which we learn reappears, dissolved in the traces that we later draw*." (2014, 59). This change is going to be fascinating for the student, but also dramatic. The beginner must learn to question and leave behind the security acquired when the objective of his learning was concentrated on finding answers. The assimilated certainties will shake as the student walks upon a slippery territory for which he is not prepared. The teaching of drawing in the studies of Architecture must necessarily help him overcome his uncertainties, providing him with a new language with which to begin his architectural career. As in the learning of a new language, it is necessary to study the particular grammar and, at the same time, become skillful in the employment of appropriate techniques in each one of the phases of communication. This new language, of highly intense learning at the beginning, will become his means of communication throughout his career, both in the university as in his professional life. Therefore, it is very worthwhile not to neglect the beginnings of this apprenticeship.

We professors are present during a stage, perhaps too long, in which the excessive value conceded to the media makes the correct transmission of knowledge difficult. If it is so easy to make a non-professional understand that he is not a writer just because he uses a text processor, it is strange how difficult it is to transmit the identical message to the field of graphic expression. Armada affirms, with great pessimism, "*The real world has been substituted by its reproduction, with media as fascinating as photography, films, television, or Internet, converted into a hunting ground and thematic park of commerce and, therefore, of power, (and that) the means of mass communication (have been) converted into agents of festivities of one sole thought*" ([2000] 2001). Without going to that extreme, we must stop to reflect on the words of Le Corbusier, referring to the teachings of the "*Ecole des Beaux-Arts*". Dazzled by the manual ability acquired by students at that time, he nevertheless expresses that "*I would wish that the brain order the hand, (…) but I would desire that intelligence dominate elegance, and above all, that it wasn't ridiculed*." (Le Corbusier [1937] 1999, 166). One can learn to see only when one becomes conscious of it. Above all, Rainer Rilke, at the age of twenty-five, while spending a long stay in Paris wrote: "*…did I already say it? I learn to see. If I begin. This is still going bad. But I need to occupy my time. (…) One should wait and ransack a whole life—if possible, a very long life—and after, finally, recently arrived, one would perhaps know how to write the ten lines which would be good*." (2000, 9–18). But it would not be fair to think that one can learn only by living, as teachers will need to begin to see long before. Siza recommends "*Do not draw for the demands of Architecture (it is sufficient to think, to imagine). Draw for pleasure, necessity and vice*." (Siza [1994] 2014c, 147).

"*If the eye must see a body too closely situated, it will not be able to judge it well; this is what happens if one pretends to draw the point of his nose*." (Da Vinci [1498] 1983, 101). If we accept that the distance at which an individual is situated from the model narrowly conditions the information the he is capable of perceiving, one may think that it would be advantageous to place the students at different distances and force them to reflect on what they are capable of glimpsing at each one. Contrasting his answers with those of the other students in an identical process, we will initiate them to the fascinating world of discovery, as we leave behind the search for an answer as the only method of learning. In this simple way, the relation between the author and the model is introduced, and, gradually approaching or distancing from it, the concept of scale. These questions about physical distance may be equally didactic if physical separation is substituted for distance in time. A temporary situation in front of the model, close or distant, further permits the discovery of invariable orders and rules in architecture, which detaches them from the moment of their conception, thus introducing a new parameter of beginning to learn to see. A bit more complex, yet not less interesting, would be the study and analysis of the distance between the model and the author himself. When reflecting on the painter Alberto Giacometti, John Berger explained that "*The act of looking was for him a way of praying; it evolved into a way of approximating an absolute that he would never reach. It was the act of looking that made him realize that he found himself constantly suspended between existence and truth*." (Berger [1966] 2000, 166).

"*When he looks, he perceives geometries or unevenness, but both are at the service of the architectural tale*", affirms Fernández-Galiano when referring to Le

Corbusier. He continues explaining: "*Le Corbusier's passion for geometry is not only a purist impulse or an aesthetic desire to reduce the objects to their essence, nor a persistent effort to identify the principle ordering concepts of the world. Behind the immaculate and precise volumes, lies a magical search for perfection and purity. Geometry's rational order clears the way to luminous initiations*." (Fernández-Galiano 1987, 28). We remember the learning of Le Corbusier in the reading of Rome in "Towards an architecture," published for the first time in 1923. He begins expressing himself this way: *"My eyes look at anything that enunciates a thought, a thought that is illuminated without words or sounds, but only through the prisms related among themselves*." (Le Corbusier [1923] 1978). If Le Corbusier understood that there was a "special language of architecture" to analyze the different "Romes"—Ancient Rome, Byzantine Rome, that of Michelangelo, or the Rome of horrors (sic)—we could well submit different models to similar analyses and unleash a new discourse in the field of graphic expression. By selecting architectonic models of similar expanses and different aspects, and observing them under only one prism, we oblige the student to look in only one direction. Doing this, we avoid distractions which would inevitably surge in the individualized study of each one of the different models. By adequately directing his look, the student will dispose of a previous aid, necessary to begin the learning of *to see.* Not wishing to exhaust possibilities, we note some aspects of themes of study: geometry, form, space, volume, promenade, place, etc. First with the thought and later, with the drawing, or even better—thinking and drawing at the same time—the student will begin to unveil the architectonic keys which lead him to discover the essence of the model, as noted by Elkins (2003) "*Drawing is* (…) *the most delicate point of the negotiations among the hand, the eye and the mind.*"

"*Le Corbusier thought with his eyes. He constructed his architecture with images connected in a narrative syntax*" commented Fernández-Galiano in the article "La mirada de Le Corbusier" (1987). He then explained the three types of vision of the architect: analytical, poetic, and narrative. In our case, once the student is initiated in the process of learning to see and after having proposed some themes of study, it would be necessary to establish a structure that would help order the content. A conducting thread between the two must be established, to create a graphic narrative. As syntax is not at all a set of rules exclusive to the graphic architectonic language, we may extend bonds towards other visual disciplines, such as a film, an illustration, or the publicity that equally participate in it. In this way, the student, familiarized with the bonds that are closest to him, can learn constantly, both inside his surroundings and faced with any other situation outside the margin of time which he dedicates to his university learning. In this way, an excessive specialization, which will end up separating him from his environment, isolated by the endogamy of architecture, will be avoided. In 1971, during an interview with the newspaper *Politiken,* Arne Jacobsen explained that "*It is rather sad. One often feels strangely hampered, one's wings clipped, one doesn't find time to bubble, and, this, despite the fact that one actually has many interests. Architecture somehow swallows up everything, it has become the whole life*" (Jacobsen [1971] 1993b, 203). Siza also reflects on this idea: "*Obsessive specialization atrophies universal* *capacities; some are permitted and imposed upon to develop some capacities-and not others*." ([1987] 2014a, 43)

"*I invite students to travel frequently. Learning to see is fundamental, at least for an architect. There is a baggage of knowledge which we must inevitably recur to, in such a way that nothing that we may do could be completely new*." (Siza [2000] 2014e, 252). To learn to see, it is essential to amplify the scope of our look. There are two different ways of achieving this: the first is natural, throughout the life of the individual, and incorporating his experiences little by little. However, we encounter the difficulty that students are young and only at the beginning of the road. This had also been noted by Rilke: "*To write only one verse, it is necessary to have seen many cities, men, and other*". The other way would be to travel, as the experience of "*travelling is an acid test, individual or collective*" (Siza 2014b, 58). On travelling, we multiply the capacity to learn, as we are open to finding and assimilating new things, "*at the same time, we lose a world of small commodities and the perverse enchantment of routine.*" (Siza 2014b, 58). As Le Corbusier stated in "Espíritu de tradición e instinto de la vida presente" (1937): "*I travel opening my eyes and sharpening my ear, nothing more*." Travelling does not necessarily imply having to explore great distances, it is more a question of attitude than displacement. It is sufficient to remember the intense learning of Le Corbusier in the *Bibliothéque National de Paris* during 1915, when he found himself preparing part of the content necessary for the publication of "La construction des villes", which he had been writing since 1910 (O'Byrne 2007, 1:30). In addition to encouraging the student to travel, one may propose simple tasks during his daily wanderings, which help him fix his attention and discover new things simply by transforming his way of looking. As teachers in the initial stage of this formation, we assume that we will not enjoy the intellectual enrichment that students will experiment as they incorporate their own particular discoveries, but we trust that these beginnings will be converted into the foundations of their strengths, remembering Rilke's idea: "*In life, there are no classes for beginners; suddenly, one is required to perform the most difficult*." (2000, 66)

"*And it is evident that the more profound the criticism, the less the possibility of failure, and also, the greater the authenticity, as incredible as it may seem.*" (Siza [1998] 2003). Recent generations of students lack the necessary and adequate strength to understand and accept that criticism forms part of the learning process. We observe how highly capacitated students consider criticism as a failure in their work, instead of evaluating it as an exam or judgment, necessary and essential in their formation. Criticism will always walk aside practice, as "*without practice, criticism will not act directly. It only steps, at intervals and* a posteriori*, the slippery territory of accidents that illuminate the future creation.*" (Siza [2007] 2014d, 400). Le Corbusier considered it this way when referring to the School of Fine Arts in Paris, and exclaiming that the notion of learning had become synonymous with suffering when he affirmed: "*Learning? But that is the joy of every day, the ray of sun in life.*" (2003, 167). Teachers find ourselves disarmed confronting the present situation. On many occasions, we must spread a totally protective blanket which avoids the "emotional" downfall of the student. Doses of patience and experience are the only recourses which we dispose of to teach generations of heirs of periods of abundance to be expecting the arrival of the sons of crisis, perhaps closer, by nature, to our own experience. When Ninka, his interviewer in *Politiken*, asked Jacobsen if the skepticism of his father had discouraged him, he replied: "*Deep inside, I did feel unhappy, but his attitude has led me to be armed to the teeth to fight to do something that is worthwhile.* (…) *It seems to me, however, that parents who criticize their children harshly are better than those who praise them in excess.*" (1971). It's not a question of "good cop or bad cop", rather about finding an equilibrated mid-point in which we are honest and rigorous with the transmission of knowledge, as expressed by Le Corbusier in 1937: "*They will be masters without titles or vanity, without wax-sealed stamps, without ink pads, without limits. They will teach young people that they must never stop learning.*" We should not search for approval and immediate satisfaction, nor should we forget that we are equally submitted to controls and evaluations which will cast doubt on our professionalism, with criticisms which will really help us to pursue this "authenticity" that Siza spoke about. We recall the words of Jacobsen in the article "Retrato de un profesor", in which he expresses a simple desire: "*As long as I can teach the young to be sincere and honest in their work, I will be certain that they will never be totally mistaken*" (Jacobsen [1956] 1993a, 198). It is a simple wish, but complicated to follow through in a moment in which sincerity and honesty do not seem to have priority.

"*Wouldn't it be more reasonable—and much less stupid—that students learn Science on one hand and English on the other, and that both be well understood?*", asked Javier Marías, with certain acidity, in his Sunday column last May 15 in an implacable article titled "Ni bilingüe ni enseñanza", questioning the implantation of bilingual teaching in the current educational system in Spain. A language is not an idiom. If graphic language is universal, we should take advantage of this extraordinary circumstance. Teaching entails sufficient complexity—of a new graphic language, in our case—taught in record time inside the new study plans, as if to add greater difficulties. Let us not run the risk of "masking" the object of transmission of knowledge once again, as I mentioned before, referring to the value awarded to the latest media. We know that other new media will always appear as the latest, which will convert the current ones into the old ones. Let us not fall into "*the poverty of the eyes that do not see*" (Siza 1998), let us distinguish our students helping them to see "*things that the rest of the people do not see.*" (Foster 2010). Remembering the words of Jacobsen: "*…as a teacher, probably the most important aim would be to try to bring to the surface talents that are hidden*", without neglecting exercise, "*so that the gestures are not contorted, and the rest along with it.*" (Siza 2014, 4). Let us return to the essence, which will remain inalterable facing whatever is currently in fashion.

"*And now, my friend, I beg you to open your eyes widely. Are your eyes still widely opened? Have you been taught to open your eyes? Do you keep them opened continuously and usefully?*" (Le Corbusier 1957).

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Graphical Analysis 2.0: Digital Representation for Understanding and Communication of Architecture

Stefano Brusaporci

Abstract Aim of the paper is to present how new technologies favor the so called "Graphical Analysis" process, i.e. the historical critical study of the architectural heritage through its re-presentation. The growth of digital technologies has affected disciplines involved in architectural studies, and computer based visualization has found in digital modeling an interpretative instrument for architectural heritage study and representation. 3D models can support a renewal of the graphical analysis and, from an educational point of view, the development of critical skills for understanding and communication of architectural characteristics.

Keyword Graphical analysis · 3D modeling · Digital representation · Interpretation · Presentation

1 Background: The Concept of Graphical Analysis

Vincenzo Fasolo, teacher of Drawing from the first decade of the twentieth century, and professor of "History and Styles of Architecture" at the School of Architecture of Rome from 1925, in 1954 published his essay titled "Guida metodica per lo studio della storia dell'architettura" [Methodological guide for the study of architectural history] (Fasolo 1954). In this book drawing plays an essential role, implicitly intended as a methodological tool for the analysis, comparison, and interpretation of the architectural characteristics and values of historical buildings. He opens his book with the following words: «The publication of the summary of the subject of the Courses of History and Styles of Architecture aims to guide young architects in reordering the graphic notes in which, according to the method adopted during the course, their observations, bibliographical research, interpretation are concretized» (p. 5). He highlights how sketches and drawings made

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tangible the students' reflections and understanding; also the bibliographical research seems to be based on graphical notes, i.e. on the representation of buildings. And he points out how the graphical language is the way for the visualization and communication not only of geometric characteristics, but of architectural values. He lists the following values: «Harmonic, modular, geometric, mathematical values; geometrical synthesis; linear, two-dimensional (relationship between solid and voids), three-dimensional (volumes—masses) values; interpenetration of previous systems; spatial values (light—colors); the fourth dimension: time and perspective view; decorative spaces; elements of harmony: unity, rhythm, eurhythmics, symmetry, dissymmetry, contrast—opposition» (pp. 10–11). We don't aim to comment on this list, but we underline how Fasolo wanted to train students to look critically at the architecture, and to understand its values. To reach this purpose, drawing is intended as an ineludible tool. And he adds: «[…] Observation and interpretation of monumental characteristics is entrusted to the young architect through a graphical summary. We demand that he practically translates into drawings those that are the elements or characteristic and essential factors and of the architecture that he is studying. Not "copies" more or less brilliantly and nicely drawn from photographic models, like the real, as at the first time one is tempted to do, for a bad interpretation of the goals of these drawn observations, instead they have to show how much and what part in the study of the program the young student has had» (p. 11): Nowadays we—in CAD used—should say: Models not only to realize photorealistic copies, but to achieve analytical, critical, and thematic visualizations.

In the second half of the Fifties, Fasolo wrote the book "Analisi grafica dei valori architettonici" [Graphical analysis of architectural values] (Fasolo 1955). The wording "Graphical Analysis" evokes the idea of structural analysis and an analytic approach to architecture. In particular Fasolo explicates the key points of his graphical methodology, i.e. a list of what could be analyzed with drawing: (A) Planimetry: single and associated plans; (B) Organisms: constructive and static relationships, balance between parts and of the whole. (C) The correspondence between the interior and exterior of the building. (D) Form and Expression achieved through plastic architectural secondary masses, and decorative contributions […]. (E) Harmonic and geometric factors (p. 1) (Figs. 1 and 2).

Fasolo says: «A history of architecture—it could be said—designed, rather than spoken» (p. 3). In our view it appears of fundamental importance the fact that Fasolo specifies: «Acquisition of culture and, especially, educational workout for the training of the quality of the architect» (p. 3). In this way drawing is not an end in itself, but a methodology related to history and—inevitably—to architectural composition.

In 1989 Mario Docci published a paper titled "Disegno e rilievo: quale didattica?" [Drawing and surveying: what didactics?], in the first issue of the journal «Disegnare Idee Immagini—Drawing Ideas Images» (Docci 1989), concerning a methodology for architectural analysis, tested by the author and his staff in the Course of Drawing and Survey held at the Faculty of Architecture of the University of Rome "La Sapienza" from the academic year 1975–1976. The paper

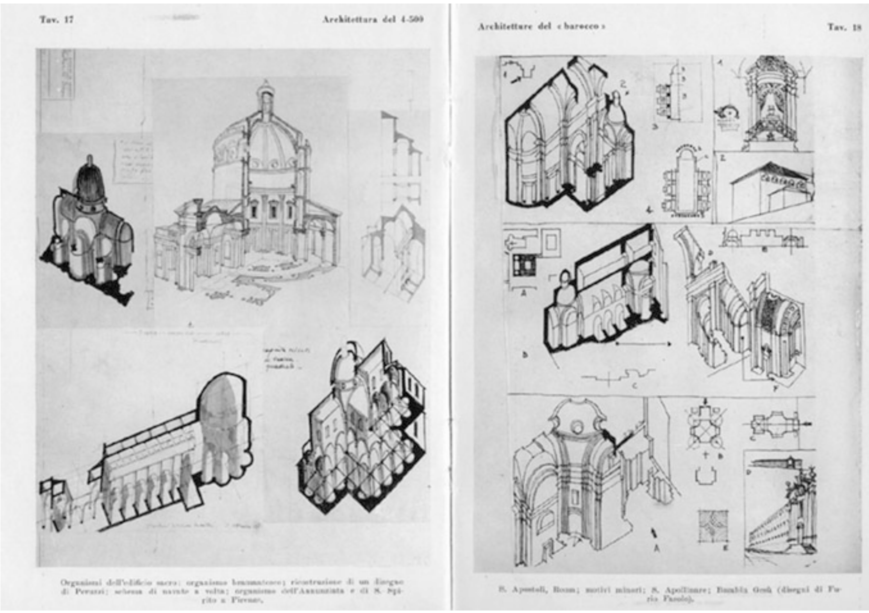

Fig. 1 Tables 17 and 18 of graphical analysis from "Guida metodica per lo studio della storia dell'architettura" [Methodological guide for the study of architectural history] (Fasolo 1954)

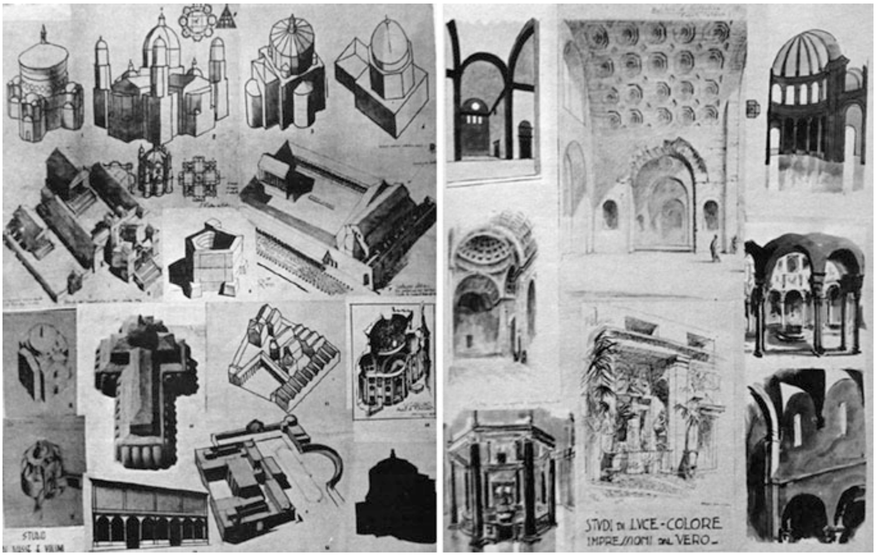

Fig. 2 Table 2 on "masses and volumes", and Table 8 on "space and color" from "Analisigrafica dei valori architettonici" [Graphical analysis of architectural values] (Fasolo 1955)

recalls what he already published in 1983 in the book "Disegno e analisi architettonica" [Drawing and architectural analysis] (Docci et al. 1983). Recalling Fasolo's lesson, and in particular referring to the structuralism lesson, drawing is regarded as a graphical meta-language useful to study the architectural language, believing that going thought the projects of great masters—modern and of the past—with drawing is a useful way to understand the architectural values. In the graphical analysis Docci identifies a methodology based on rigorous criteria that allows to study proportions, volumes, forms, configurations and structures, and the relationship between the elements that contribute to the conformation of the architectural language. Thanks to drawing, the scholar makes an ideal segmentation and selection of the architectural work, to represent its constitutive elements. Although in the educational, he develops a method of critical study, believing that the drawing and the re-presentation of great masters' graphic—past and contemporary—are a useful tool to understand the values and therefore a pre-requisite for the project.

Docci indicates the following analysis: distributive, of structures, formal, spatial, of the relationship between the work and its context (p. 39). In particular, about the formal analysis, he suggests to study the following aspects: Side closure elements (facades); Connecting elements with the ground (relation with ground); covering elements (roofs, terraces); connecting elements between the side closures (corner solutions); Outside-inside connecting elements (entrances, foyers); vertical connecting elements (stairs, ramps) (Docci 1989, 42).

For several years, in the Curses of Drawing of Architecture and Engineering Degree Courses, the teachers asked to the students to read and analyze graphics of buildings from journals of architecture, and consequently to re-draw floors, elevations and sections, then to elaborate new interpretative representations, also with the realization of maquettes and CAD models. Sometime the work of graphical analysis is made according to the surveying of the building.

The challenge today is a re-conceptualization, to decline the lesson of the graphical analysis according to the tools and methodologies of digital representation. There are numerous publications about experiences on graphical analysis based on digital tolls (Apollonio 2012; Albissinni and Chiavoni 2014). It is diffused the line aimed to study the characteristics of no more existing buildings, or with deep transformations, or only planned (Centofanti et al. 2014). Between many examples, we cite the works of Calvano and Ippoliti (2015) and Albisinni and De Carlo (2001) that present an experiences based on the use of 3D models for the analysis of buildings of modern architects. The studies, which moves from the study of original drawings derived from historical archives, favor the analysis of these authors and of their works in relation to their historical context. 3D models—projected, sectioned, exploded, and navigated in Virtual Reality and Augmented Reality—promote critical representations.

The main conceptual and methodological difference between traditional graphical analysis and digital analysis is that the representative model now is three-dimensional, complex (synthesis of multiple aspects), easily modifiable and dynamic. Therefore, moving from established drawings to computer based visualizations, the kind of representations changes: less and less static sectioned views but interactive navigable models.

2 Brave New Models

Illustrating the "graphical analysis", Docci agues on the concept of "model" as way to identify and express the relationships between the constitutive elements of the building: «We use the graphic medium to create understanding models of the architectural work and of urban spatiality, in order to be able to comprehend and analyze them, as well as a scientist who reproduces, in his laboratory, artificially a phenomenon. The drawing, thus interpreted, is identified with the concept of the model, or better of graphical model of understanding. It should be noted, in this regard, that such a model is really a model when it is composed of a set of elements linked together by the same rules that link together the constitutive elements of the space described by the model; therefore, it doesn't represent the work like it appears, but it establish an analogy with the purpose of underling laws that regulates the organization of the work itself. Then it is a process of complexity reduction of the architectural reality, aiming to point out significant aspects, highlighting them in a schema» (Docci 1989, 38–39).

He refers to traditional two-dimensional drawings, but the graphical analysis methodology could find a new way of developing in 3D modeling technologies. Compared to traditional graphical analysis, made by two-dimensional drawing such as plants, elevations, sections, perspective and axonometric projections, 3D models allow continuous non-linear, multi-dimensional, and multi-level interpretations, favoring visualizations and diachronic simulations (Migliari 2008; Brusaporci 2013).

They have great expressive potentialities, but at the same time, they require technical skills and critical awareness to don't lose sight of the goal: The study of an architectural heritage.

The digital model presents two related "natures", i.e. the indissoluble coupling of "geometric modeling" and "rendering modeling" (cameras, lights, textures, visualization modalities, etc.). They may be intended as the two faces of the same coin: the "signans", which has to be conducted to the true icon of the "signatum". And in the definition of the final representation, we have to remember a further step: the one of post-processing, often not less important than the others for the visualization of the architectural environment and for the overall perception. Last but not least, "modeling" means not only geometric shaping or visualization: Modeling is also about the architecture of data and information about the building (Murray 2012). Therefore the database has to be planned at the same time and in relation to the 3D model. An example is given by BIM software, able to gather the different characteristics of a building, and that are even more used to model historical buildings.

Therefore, unlike the traditional hand-drawing, where tracing the signs you get in real time the graph—according to a synchronic relationship mind-hand-graphic —, in digital representation there is a procedural gap between modeling, rendering and ready visualization. This requires a sort of rationalization of geometric modeling, render modeling, and database modeling, but this pipeline could have a heuristic function: realizing the model, the modeler represents his mental idea of the building and, at the same time, he can compare this idea with the real architecture. It is an iterative process of hypothesis and validation, and representation favors the perception and understanding of the reality, because it helps the observation and examination of it. The greater is the technical capabilities, the culture and the level of investigation, the better is the result, i.e. the better the representation can describe the characteristics of the architecture (Brusaporci 2015).

The critical skills of the student grow, because he has to think, prefigure and design the final effect of the representation. Because from a single model you can achieve infinite representations, we want to avoid that the search for the best final performance—the one considered more meaningful and communicative—occurs for random attempts. Therefore with building and representing the model, the student develops abilities in “reading” and “talking” about architecture: fullness and emptiness, spaces, volumes, lights, transparencies, materials, etc.

Obviously we have to highlight what are the main opportunities offered by digital models: they can be freely and easily navigated, modified, sectioned, broken up, exploded, represented in different ways (of lights, materials, environments, etc.). That is they provide smart conditions for the simulation, and favor the study of that architectural characteristics cited by Fasolo and Docci.

Compared with traditional graphics analysis—based upon the realization of a series of thematic graphical models (drawings)—, with digital technologies the process changes: now we build a continuous (although semantised and layered) model—we could say a “full master model”—, reproduction of the building’s continuum, and then, from this conceptually unique (and complex) model, we derives critical interpretations (Figs. 3 and 4).

In any case, the relationship with the reality is important—the direct and physical experience of the building and its context—, even more when we deal with architectural heritage. From an educational point of view, the comparison between the model and the reality is useful (for example with the contrast of computer based views and images from the real, taken by the students or by professional photographers and published in architectural journals). The relationship with reality must be critical: not a photorealistic camouflage of photographic images from real, but as validation of the understanding and communication characteristics of the computer based visualization. In this way photorealism (intended as “graphical” quality of the image) can be important, but not necessary a priori (Figs. 5, 6 and 7).

Similarly, the comparison between the physical model and the digital model could be useful for developing communicative abilities: through the parallel between the physical space of the maquette (that can be “touched” and experienced directly) and the one represented by the virtual model, students can develop skills in

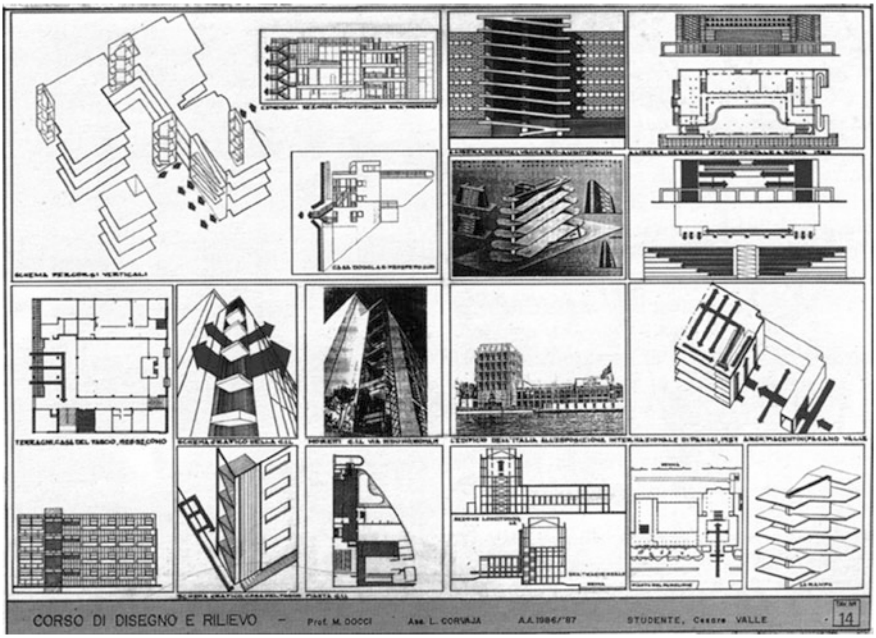

Fig. 3 Example of graphical analysis from "Disegno e rilievo: quale didattica?" [drawing and surveying: what didactics?] (Docci 1989, 46)

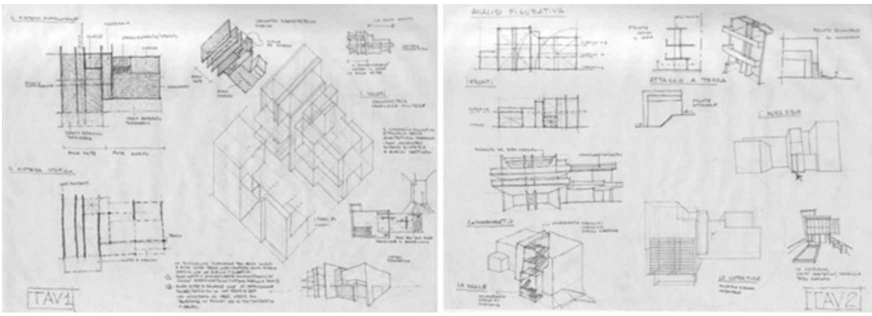

Fig. 4 Hand-sketches of graphical analysis. Palù & Bianchi Architects, Villa on Garda Lake (S. Brusaporci)

reading and understanding digital representations and in foreshadowing rendering representations.

Last but not least the freehand drawing ability (Pallasmaa 2009) does not lose importance, but comes back on top: For example with perspectives, isomeric drawings, and shaded sketches, the modeler thinks and understands geometries and characteristics, prefigures and designs 3D models and computer visualizations (Fig. 8).

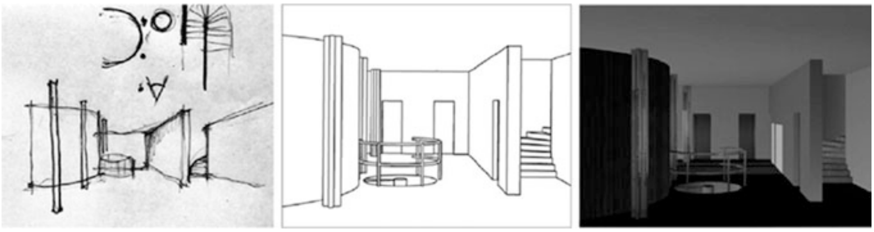

Fig. 5 Designing the digital visualization: from sketch to textured rendering. Mies van der Rohe, Tugendhat House—Brno (L. Centorame, Teacher Prof. S. Brusaporci)

Fig. 6 Perception and understanding: visual comparison between rendering of the current building and ones with different materials and environments. Mathias Klotz, Reutter House—Cachagua, Cile. (U. Di Vincenzo, Teacher Prof. S. Brusaporci)

Fig. 7 Understanding and Communication: the physical model and the digital model. Steven Holl, Saint Ignatius Chapel—Seattle University, Washington (S. Cioffarelli, Teacher Prof. S. Brusaporci)

Fig. 8 Understanding and communication: the real & the rendering. Antonio Citterio, Kindergarten, Verona (S. Placidi, Teacher Prof. S. Brusaporci)

3 Digital Models for Graphical Analysis: A Line

The paper presents a research aimed to study how new technologies favor the "Graphical Analysis". The work has been developed in the education and has been organized according to a workflow that moves from hand analytical sketches, maquettes, 2D CAD drawing, and 3D modeling; and it goes on with three main steps of increasing critical level: (1) The visualization of the Model: wireframe, shaded and textured views (orthogonal and isometric projections, perspectives). (2) Perception and Understanding: different rendering configurations to compare distinct point of views, camera characteristics, materials, lights, peoples, environments, vegetation, uses and functions of the building. (3) The Analysis of the Architectural Characteristics of the Building under examination: facades, roofs, corner solutions, relationship with the ground, entrances, stairs, etc. In particular the last one is focused on the understanding and communication of the building's architectural values.

Recalling what Fasolo wrote in "Analisi grafica dei valori architettonici" [Graphical analysis of architectural values], we could trace a correspondence between traditional and digital graphical analysis: The "3D modeling" requires the understanding of volumes, masses, surfaces, modular systems, proportions, dimensions, etc. The "Rendering" needs the study of materials, lights, point of views, itineraries, etc. The "Context" is more complex, in part realized with models, in part with raster background and/or billboards.

The correlation into the same system of 3D models and informative models allows the association between archival-bibliographical information and the components of the building.

The phases of sketches, modeling, and representation, although separate from an operative point of view, actually are interrelated, and each one influences the others.

All the steps require a critical engagement, because the student has to study the building and represent it in an iterative way.

We think it is very important the critical comparison between the digital model and the physical model, and between renderings and pictures of the real building—where the photorealism is not the main aspect—with the aim to understand if the rendering communicates the architectural characteristics and values, like pictures. Last but not least we highlight the relationship between hand-drawings and CAD, where the sketches—realized according to a rigorous use of descriptive geometry—allow the visualization of the concept and the design of the computer based visualizations. The purpose is to favor the development of critical skills (Fig. 9).

Remembering the studies suggested by Docci, and in particular the ones for the "formal" analysis, follows the list of works required to the students:

1. Interpretative hand sketches (floors, elevations, sections, volumes, etc.) of the building and of buildings with similar solutions (of the same author(s) or of others, of the same period of other ages); volumetric maquette; defined maquette.
2. Two-Dimensional Models: 2.1 Floor plans (At least one floor in scale 1: 200, 1:100 and 1:50—i.e. with the respective details and contents). 2.2 Sections. 2.3 Elevations. 2.4 Diagrams illustrating the functional and of distribution characteristics.
3. Three-Dimensional Models. 3.1 Derive from the model the following views (use different display modes: wireframe, shaded, textured): axonometry, esploded axonometry, axonometry viewed from the bottom, prospective of the building, prospective of internal spaces, internal plan-perspective view. 3.2 Derive from the model visualizations to show rendering abilities (images must illustrate the building both externally and internally, and for each following item min. 2 images with different rendering settings): kind of projection (orthogonal, axonometric, plan-perspective, perspective with not vertical picture plane), point of view, virtual camera settings (with the same point of view), materials (for example textured walls), lights (day and night, or at different hours), people (only shapes with different transparency, 3D rendered models, post-processing inserted, etc. of different age, gender, clothing, etc.), furniture (inside), street furniture and vehicles (outside), greenery, background. 3.3 Comparison between

Fig. 9 Formal analysis: the roof. BKLS Architekten, Werner-Heisenberg Guest House—Leipzig (M. Di Lisio, Teacher S. Bruaporci)

Fig. 10 Formal analysis: the relationship with the ground. Thomas A. Heinze, Massaro House—Mahopac Lake, New York (D. Caramanico, Teacher Prof. S. Brusaporci)

images of the physical model and renderings. 3.4 Comparison between pictures of the building and renderings.

4. Formal analysis of the building (for each following item min. 2 images): facades; relation with ground; roofs and terraces; corner solutions; entrances and foyers; stairs and ramps. The computer based visualizations must be combined with freehand drawing, made to design digital representations.
5. (Last but least) Brochure—it has to be realized and developed during the whole work—: studies and researches on the building (what is, where is [find it on Google Maps and Street View; if not so far, go to visit it], when it has been realized, who commissioned it and why, etc. where it is published and bibliography, how it is made, etc.) and on the author(s) (who is, where he work, other works, bibliography, etc.) [Try to contact the author(s) by email and ask for further information on the building]; synchronic and diachronic analysis about the author(s) and the building; communication of the building's characteristics (all the manual and digital representation realized for the graphical analysis, accompanied by photos of the building and of the maquette, with explicative captions) (Fig. 10).

4 Conclusion

Digital representations substantially don't change the idea of "graphical analysis" but offers new tools to approach, understand, know and communicate the architecture. This experience highlights some conceptual and procedural issues: Designing Digital Visualization: from sketches to textured rendering; Perception and

Understanding: the skill to read architectures; Understanding and Communication: the ability to narrate (and comment) architectures.

From an educational point of view, to reach these aims, it's important the mutual visual comparison between the current building or physical models and renderings.

And it's interesting to put side by side the visualizations made by different students to describe the same building.

An operational reassembling between the long-established experience and the new digital one could be made by the hand-drawing: It carries on the values of the tradition and stands as prodrome for the analysis made possible by the advanced digital tools.

The research may suggest new lines, for example according to the issues related to the use of BIM software, or in relation to digital surveying of architectural heritage and, consequently, its modeling, representation and communication, and visualization to prefigure architectural restoration design.

In conclusion we recall the well known DIKW problem, i.e. Data—Information—Knowledge—Wisdom hierarchy (Ackoff 1989). This hierarchy is usually represented by a triangle with "data" on the base and "wisdom" on the top. The triangle suggests the claim for a wise understanding in moving from the base to the top. In this way, graphical analysis could configure a similar problem, with the necessity that the student moves from the comprehension of data and information on the building (historical and "physical" information) to the understanding of the architectural values, also in comparison with ones of other buildings. Then the wisdom in communicating and designing architecture follows.

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On the White Scale Model (Un)Purpose…

João Miguel Couto Duarte

Abstract White scale models appear as a regular representation in architecture's teaching: the unique material allows a student to better focus on his/her work, facilitating design's learning. Although it may seems convenient, this adoption of white scale models deludes its representational nature. Acknowledging three underlying misconceptions related to the adoption of white scale models—its natural adequacy to express though; its negative value in regards of the difference between representation and its object; the subsidiarity of representation towards thought—, it will be revaluated the impact of representation on thought and the way it should be considered in architecture's teaching.

Keywords Architectural scale model · Misconceptions · Architectural representation

1 Initial Considerations

The learning of architectural design implies—and it may not be in any other way— the control of representation systems of architectural objects. Since this control is not always granted design's learning may be difficilitated.

Therefore it urges the adoption of the "white scale model"—it should be acknowledged that sometimes this is imposed. Even if the domain of tridimensional representation is relative—and it is frequently—the monochromy of one sole material delimits its expressive possibilities, allowing the future architect to better concentrate on its work object. It is believed that the white scale model enables a

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bigger transparency of thought. And this is a determining value of representation, in particular to the learning of architectural design.

But it is necessary to consider the meaning of this purpose. Sustaining this way the adoption of the white scale model, intending that it will assure a bigger transparency of thought, may seem to deceive the nature of representation. The impact on thought will be something else more radical. That same nature makes it consider it this way. It is this impact of representation on thought that is going to be evaluated, in particular on design's learning.

Recovering the purpose of its adoption, in which origin it is possible to find a certain understanding of Alberti in *De Re Aedificatoria* proposals, this reflection will be established from three other more confined reflections interlinked around what it seems to constitute three misconceptions related to the white scale model's adoption.

2 The Purpose of the White Scale Model

The white scale model remains a current representation in architectural design's learning. From the beginning it is justified by the readiness of how it is understood, especially when compared to the difficulty sometimes created by drawing's understanding, which is worsen in technical drawing. But it can also be justified by its tridimensional and constructive constitution that grants it a particular proximity to the architectural objects that it represents. "Making a model is about as close as one can get to the actual construction of a design idea, and can be used for a variety of different functions" (Dunn 2007, 34). Therefore the role of the scale model in design's learning is privileged enabling it from the initial ideas formulation to the presentation of final proposals.

This scale model's appreciation mustn't deceive its representing condition. Because it is in fact a representation the adoption of the scale model also lays on the manipulation of a coding system without which communication would not be possible—"Toda representación, incluso la visual, es pues convencional y por lo tanto se rige por unos códigos que permiten su interpretación" (Úbeda Blanco 2002, 76). It will be the control of those conventions that will allow, at least in part, the success of the final school sphere's scale models—"this model type by definition is clearer and exploits accepted conventions that encourage the exploration of the image as well as the medium in order to convey information" (Dunn 2007, 43). The utilization of scale models implies therefore some sort of learning. And if this is an almost always imperceptible process it's because it's a result not of a minor codification importance in understanding a scale model but because of the way that codification is perceived. "[E]very adult has been through an intensive number of years as a child, using miniaturized and scaled objects called toys. Years of learning to control, manipulate and subvert these representations of the adult's world, means that no adult can be fooled by a model" (Selenitsch 2007, 5).

The identification of the coding systems present in a scale model exceeds this reflection's scope. Nevertheless it is important to mention that even the notion of scale associated to the scale model, even if it is a mere mathematical conversion, also has an underlying codification (Smith 2004). It will be more important to observe the limits of those codes, in particular of those that determine the model's expression. Scale models enables to establish a particular approach to architecture but excessive realism should be prevented. Contribute for that limitation both the idea that realism is devoided of a critical dimension and its association to the miniaturization of reality. “The strength of architects' reaction to realism is usually in direct proportion to their conception of themselves as artists” (Moon 2005, 132). The notion of abstraction is therefore opposite to the notion of a reduced reproduction, making scale model representing not its object, even because in architectural design that object remains still undefined, but it's underlying principles.

The learning of the scale model's codes has consequences there. If due to the habituation observed by Selenitsch (2007, 5) the representation of geometrical configurations of reality should be more easily controlled by a student, the representation of its material values—colour, texture, materiality, etc.—on the other side should not. And by its representation not being controlled, having an attempt to reproducing those values—and this is a current attempt—the clarity of a scale model could be endangered, endangering that way the evidence of the generative principles of the architectural object in definition, which is the evidence of the thought that the future architect tries to develop. The white scale model therefore emerges—sometimes by imposition as it was referred. The monochromy also imposes a codification of the representing information. Nevertheless, because it is a priori defined, this codification allows to obviate the problem of representing some values of reality—at least it is this way believed. Monochromy standardizes them. White scale model will then make obvious the rigor of geometrical configurations, the clarity of the games of shades, the plight of the spaces' proportions, enabling the future architect to better concentrate on his/her work. White scale models seem to be naturally suitable for them.

In the more immediate origin of the white scale model could be the practice of several known authors that architecture's teaching tries to emulate. Somehow its practice imposes a standardization of architecture's representation. Nevertheless in its deepest origin it will be possible to discern the reflections proposed by Alberti ([1485] 1986) in *De Re Aedificatoria*. When sustaining the intellectual status of the architect's work, and by that way when dissociating it from the artisan's manual labour, Alberti is defending that scale models should not be “too exactly finish'd, nor too delicate and neat, but plain and simple, more to be admired for the Contrivance of the Inventor, than the Hand of the Workman” (Alberti [1485] 1986, 22). In its simplicity scale models arise as an evidence of the intellectual dimension of the architect's work. It is this evidence that white scale model try to secure, in a process that reflects a conviction of that intellectual dimension of the architect's work primacy over the material condition of the adopted representation to perform it.

The white scale model has therefore the purpose of facilitating the expression of thought. And that purpose reveals to be more convenient as the development of that thought is still being apprehended. But this is a purpose that seems to be marked by some misconceptions: firstly because of the misconception of believing in the natural adequacy of a certain representation to enable thought to emerge; also, and believing in that particular adequacy, because of the misconception of taking the existing difference between representation and its object as a negative one towards the process of designing and its learning; finally because of the misconception of considering thought as an instance not only distinctive of but also autonomous from representation. Afterwards it will be another one, a more radical one, the impact of scale model on architectural design.

3 The Adequacy of Representation

Today it is clear that representation does not constitute a vehicle exclusively for thought and that it will not be depleted by this process. By being represented thought will be transcript into a certain system of codes that will necessarily shape its understanding. That is the result of the Latin origin of 'to represent'—'*repraesentare*' means to make present, because of which the comprehension of what is thus expressed will not escape from the contingencies of a representation that conveys it a presence.

The impact of representation in thought has been being reviewed, which is explicit for example on the observations proposed by Gänshirt (2007). "[I]deas, thoughts and visions cannot be conveyed directly; they can be expressed only with the aid of "tools", "instruments" or "media"" (Gänshirt 2007, 81). By constituting itself as a condition for its transmission it is necessary to recognize that representation has an impact on thought. But there is more to it than that. "Tools do not only shape our concrete actions, but also our thinking" (Gänshirt 2007, 90), meaning that besides its transmission that impact reaches the very definition of thought this way transmitted.

The recognition of this impact evokes a reevaluation of representation. Its neutrality is no longer sustainable but its adequacy can still be considered. This is the opportunity of the white scale model. By limiting its expressive possibilities and concomitantly by giving evidence to its tridimensionality, by being therefore reduced to the quality that distinguishes it as a representation of architecture, the white scale model seems to bear a natural adequacy to turn present the thought that the future architect is trying to develop.

It lays there one of the misconceptions underlying the white scale model's adoption.

Intending to sustain its natural adequacy to make thought transpire implies after all ignoring its representational condition, in other words, the arbitrary and strictly regulated process of geometric mediation on which lays its comprehension. Only occurring this process—an arbitrary and strictly regulated process—it will occur representation. This condition has already been verified for the scale model by Úbeda Blanco (2002, 76). It is under the light of that condition that the white scale model should be observed, including the tridimensionality that shares with architecture. Therefore if that is an arbitrary and strictly regulated process, the adequacy of the white scale model will result not from a natural capacity to reveal its object but from the way the conventions through which reveal it are valued. And in that valuation it is played the degree of realism—or of abstraction—, among other questions, which is admitted by the context that convokes representation. "Realistic representation, in brief, depends not upon imitation or illusion or information but upon inculcation. (…) If representation is a matter of choice and correctness a matter of information, realism is a matter of habit" (Goodman 1976, 38). This conclusion should be extended to abstraction.

It is then the appreciation of a certain abstraction of reality and therefore the demand of affirmation of a certain information when representing it that establishes the adequacy of the white scale model as a representation of architecture. Thus its adequacy is circumstantial and therefore relative as it is the adequacy of any representation.

4 The Difference of Representation

The conviction on a natural adequacy of the white scale model as architecture's representation brings to evidence the difference that will always exist between representation and its object. It is the recognition of that difference, and therefore the desire to overcome it, that motivates the adoption of certain representations. Somehow it is believed that they will get closer to their object. From this comes its pretence adequacy. The importance recognized to the scale model is of this an evidence, as it is confirmed by the former referred observation by Dunn (2007, 34).

The difference between representation and its object it is not at stake now since it derives from its own constitution. If representation duplicated its objet in all its completeness, if it was not differentiated from it, it would be that object, devoiding itself from its meaning. Representing will always be interposing a difference. And the same will happen with the scale model in spite of that particular ability that it seems to hold to reproduce its object. Thus being evident its existence, it is at stake the way that difference is valuated. It is true that that difference will enable to solve the impossibility of taking the reality in all its completeness but, when the object of representation still doesn't have autonomous existence from the record that unveils it and when the processes of its definition are still being apprehended, that difference seems to be opposite to thought's development.

Another misconception underlying the adoption of the white scale model is rooted there even if the difference between its object is evident.

It is important to understand the meaning of representation to the understanding of its object. Above all it is at stake the way it allows to generate information without which representation as a way of amplifying that comprehension would be devoided of meaning. If on a representation one only seeks to confirm what is already known, if it only prevails the illusion of the presence of the object in definition, thought will run the risk of selfsameness. On the contrary if one recognizes the difference that representation holds to its object, if one accepts that difference as a value of representation, thought may be clarified. That difference matches a fringe of lack of definition which interpretation will evoke the surge of new information that could be relevant to the understanding of the object in project. And from the beginning that is a possibility that will occur throughout the elaboration itself of representation. It is this other way of understanding difference that is found on Zumthor's ([1999] 2006) reflections, when the danger of trying to cover the lack of definition of representation is identified. "If the naturalism and graphic virtuosity of architectural portrayals are too great, if they lack "open patches" where our imagination and curiosity about the reality of the drawing can penetrate the image, the portrayal itself becomes the object of our desire" (Zumthor [1999] 2006, 13).

White Scale model should disclose those "open patches" even if it is its existence what one tries to prevent. After all on the white scale model hovers the possibility of becoming just a longing object.

5 Representation as Thought; Thinking as Representation

The previous reflections tried to readjust the understanding of the established relation between representation and thought, specifically design thought—instead of being a natural condition of itself, the adequacy of representation is circumstantial and relative since it will always be determined by the context that convokes it; and instead of being relevant because of the proximity it may establish with its object, which will always be elusive, it is relevant because of the way it differs from it. But a distinction between both statuses remains present: although it requires that distinction in order to be transmitted thought still remains to be observed as holding an ontological precedence over representation and therefore being representation as subsidiary to thought. The conviction that "[t]here is a danger with any of the possible "tools" that they could falsify our ideas" (Gänshirt 2007: 81) confirms it.

A third misconception underneath the adoption of the white scale model lays there. As all the previous ones it underlies all representation after all.

It is important to observe the way the recognition of something on a representation takes place. When resulting from an interpretation process—its already referred abstract and strictly regulated condition determines it this way—the understanding of a representation will allow the formulation of a mental image. Only this way it will be possible to replace its object despite of the differences that distinguish them. The understanding of a representation is not distinguished there from the understanding of other objects which is not distinguished therefore from the understanding of reality. Since they don't have their own meaning, because they are not gifted with it, the meaning of the objects will be the one given by the subject when apprehending them. Objects are also composed as mental images. And it is as mental images, and exclusively under those terms, that they remain in memory. Janeiro (2010) identifies objects as 'significant formulations' consequently coming to the conclusion that "as qualidades *do* objecto são, no fundo, projecções subjectivas que qualificam o objecto. (…) É o sujeito quem nele deposita certas qualificações—elas são, por isso, de ordem subjectiva e não de ordem objectiva" (Janeiro 2010, 106). This oncoming of representation's comprehension to the object's comprehension must be now observed in the opposite way. Therefore if objects gain existence when conferring them a meaning—and recognizing an existence in them is already giving them meaning—then objects should also be observed as representations since it is when they are signified that they become present. Giving objects meaning as replacements of others is after all just a circumstantial volition. No object intrinsically has that meaning.

The distinction between the statuses of thought and of representation can now be resumed. If, as it was observed, it will not be sustainable to distinguish objects taken as representations from other objects—since they are given as mental images all are 'significant formulations'—for the same reason it will not be sustainable to distinguish representations from mental images—"ideas, thoughts and visions", as they were referred to by Gänshirt (2007, 81)—whose transmission they should ensure. The distinction between a representation and one of those images is rooted not in the concreteness of one and the abstraction of the other one but in the identities that, while mental images, one and the other possess and that result from the circumstances where their apprehensions are registered—"Nothing is seen nakedly or naked" (Goodman 1976, 8). When proceeding with a representation one proceeds with the confrontation of two distinct mental images: the one that convokes the representation and the one that is apprehended in it and that will determine a necessary adjustment to the first image. Only a convention will allow relating them. The deeper impact of representation in thought is rooted there in that adjustment.

Opposite to being ontological the precedence of thought over representation becomes just chronological after all. Thought and representation are just one.

6 Final Considerations—The (Un)Purpose of the White Scale Model

The previous reflections were initiated by the proposition of the white scale model in the learning of architectural design. From what it seemed to origin three misconceptions underlying its adoption the understanding of the impact that representation would have there was at stake.

Opposite to being natural it was verified that the adequacy of the white scale model to represent thought is circumstantial and relative, as it is the adequacy of any representation after all; and, on the contrary of making it difficult it was verified that the difference between representation and its object is determinant to clarify thought; finally, and opposite of being distinctive, it was verified that both statuses of thought and representation are from the same nature. Therefore the impact of representation in thought comes from the adjustment to which representation compels it. And that is also the impact of representation when thought has a design dimension. To the just verified adjustment corresponds a successive readjustment of mental images that will only be concluded when a satisfactory definition of the object being conceived is achieved. The relation established between thought and representation when one tries to invent reality is not distinguishable from the relation established when one is trying just to contemplate it. After all both come from the confrontation of distinctive mental images. It is always (Fig. 1).

But is white scale model irrelevant to the learning of architectural design? No. Being a representation the white scale model will also be a possible way to the future architect to confront his thought and to learn how to develop it. But more

Fig. 1 Work scale models of architecture's students, Universidade Lusíada de Lisboa

than making a particular system of representation relevant it will be important to make one understand the underlying arbitrariness in the relation that all representation establishes with its object, the importance of the difference held from it and the successive reconfiguration that thought convokes. This will be one of the challenges of teaching design in architecture. Symptomatically when asked about the reason why they adopt the scale model some students answer: "'to communicate my design', 'so I could see it in 3D' and, perhaps rather disconcertingly, 'because I was told to'. (…) In only a few cases did the students state that they were making a model to explore or develop their design ideas" (Dunn 2007, 39–40).

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Teaching Drawing as a Code or Diagram—Mirror or Map—, and Its Correlation with the Right or Left Brain Hemispheres

Aurelio Vallespín Muniesa, Noelia Cervero Sánchez and Victoria González Gómez

Abstract Inexperienced students of architecture are better at copying an inverted drawing than at copying the original. Edwards relates this fact to the way the brain hemispheres work. While the left one is verbal, rational, sequential, and articulates language, memory and mathematical aspects, the right hemisphere is intuitive, perceives overall patterns and images rather than parts and is dominated by emotion. Learning how to draw is learning how to access the perceptive part of our brain (Edwards [1979] 2000, 83).

Keywords Map · Code · Diagram

Betty Edwards has pointed out that when students without drawing experience try to copy an original drawing rotated 180 degrees, such as Picasso's Stravinsky portrait for instance, the result is significantly better than when the drawing is copied from a non-rotated source. Edwards says this phenomenon is associated to the way the brain hemispheres work. The left hemisphere is verbal, rational and sequential; it is related to speech, articulated language, memory and mathematical processing. On the contrary, the right hemisphere is intuitive, works through patterns and focuses on the whole picture instead of its parts in a perceptive and emotional way.

Drawing requires use of the less dominant right hemisphere, forcing the brain to work without the fast, analytical and dominant left part. Accordingly, when we try to draw an inverted portrait we are imposing obstacles to the left hemisphere to access the right one. Learning how to draw therefore implies accessing the perceptive side of our brain (Edwards [1979] 2000, 83).

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Curious about the reasons because students were more proficient in copying inverted drawings as well as about the way they begin to have good command—which usually happens all at once instead of gradually—, Edwards directly asked her students about the changes experienced through their working process. She discovered that when “working with negative spaces they were able to discover more things but also to find more mysteries. Students were able to draw better when they didn’t look at the shape they wanted to copy, but to the space surrounding it instead” (Edwards [1979] 1988).

This shift on perception was somehow known from the laws written by the Gestalt physiologists, who studied how the human brain organizes perceptions into groups or unified wholes (gestalts), under certain principles. The “Gestalt Principles” describe general postulates found in each perceptive process, proving that our brain tries to “make the best possible organization” of the observed elements. The theory was summed up in the famous statement “The whole is other than the sum of the parts” (Leone 1998, 1), from which we conclude that the brain forms images from perception, establishing a series of links between the different elements, completing, adding and organizing, by reasoning.

Gombrich ([1982] 2000, 176) described the different kind of information we can get from representations and was able to discern between those maps offering selective information about the physical world and those frames, i.e. mirrors, offering information about the optical world. In other words, and in relation with Edwards’ theories, maps would be related to the left-brain hemisphere while mirrors to the left.

Deleuze ([1981] 2008, 143), on the other hand, defined painting as the ultimate analog language, in opposition to what we could consider the digital one, which is the way we communicate through an articulated language. According to Deleuze ([1981] 2008, 127–150), codes are digital and diagrams are analog, so we could associate code and digital with the left hemisphere, which is connected to the idea of map as explained above, and diagram and analog with the right hemisphere, respectively connected to the idea of mirror.

As we delved deeper into this issue, we realize that they are not isolated areas and, in fact, one is always developed as long as the other participates. Analog language is essentially defined by similarity while digital is essentially defined by convention. We also find similarity cases on codes, concluding that this phenomenon is actually not enough to define analogy. There are three different forms of analogy and only one of them, known as common analogy, works by similarity while the other two are organic and aesthetic analogies, (Deleuze [1981] 2008, 153). The sort of analogy produced by unalike means is the most significant, giving a more intense and profound similarity. Organic analogy consists in implanting codes, that is to say codifying the analog, understanding that “any code is part in depth of an analog flow”. On the contrary, aesthetic analogy is defined by modulation and consists in “producing similarity by unalike means” (Deleuze [1981] 2008, 167).

Margarita de Luxán and Fernando Lancho gave an interesting lecture about architectural competitions during the 14th EGA International Congress celebrated in Porto in 2012. In their presentation, they clearly differentiated two levels: one about design method, represented by a pair of opposites composed of the idealistic and the constructivist, and another about the communication method, represented by a pair of opposites composed of Deleuze's analog and digital theories. Basically they linked idealistic to analog and constructivist to digital, so consequently they stated that when architects have to put together a board for an architectural competition, combining design and communication, "an idealistic proposal becomes feasible under a constructivist approach while a constructivist approach is appreciated because of the underlying proposed idea" (Luxan y Lancho 2012, 887).

Despite the different approaches, we conclude that they all look at the same problem from different points of view, which is why the terminology is diverse. In other words, we are saying that drawing has not only an expressive and intuitive factor, but a narrative, rational and sequential one as well, implying the existence of a pair of opposites: the right versus left brain hemispheres, according to Edwards, mirror versus map, according to Gombrich, or diagram versus code, in the words of Deleuze.

In this regard, architectural drawings are generally more balanced between intuitive and rational factors than conventional drawings, which adds an extra layer of variations to the already complicated relationship between opposites. Those variations for Luxan and Lancho are idealism and constructivism. We should also consider that the pair of opposites cannot be understood independently, very often one has to be interpreted through the opposite. We could therefore say that pairs of opposites overlap at different levels, as thinking and communication, being this circumstance in fact the origin of its interest.

Juan Antonio Cortés has also written about the interlacing of opposites in his essay entitled "The hands of the architect", where he describes the dualism of our brain when analyzing and designing architecture with drawings. For him, hands are just 'tools for the brain', which execute the stimulus generated and are therefore in charge of overlapping the digital-constructivist pair with the analog-idealist one. Further to Cortés' point of view "some architects are more intellectual and others are more visual, because some are led by reason and others by their senses" (Cortés 2006, 126). He considers that the levels of relationship between pairs of opposites depends mainly on the area of the brain used, and those range from rational to emotional in terms of result.

A good example of the relationship between pairs of opposites could be Sant' Elia's drawing Power Station, from the series New City (Fig. 1). This drawing can be easily interpreted from digital codes but it also reveals a deep emotion from its analogies. The chimneys, represented as harmless elements in opposition to the dangerous falling sky, become an aesthetic analogy, a diagram. However, the representation of other elements, such as the wiring, can be understood as a code, perhaps generated from analogy, but code after all. Analyzing the balance between diagram and code on architectural drawings becomes interesting because we are able to distinguish the dose of intention together with the technical component attached to this type of work.

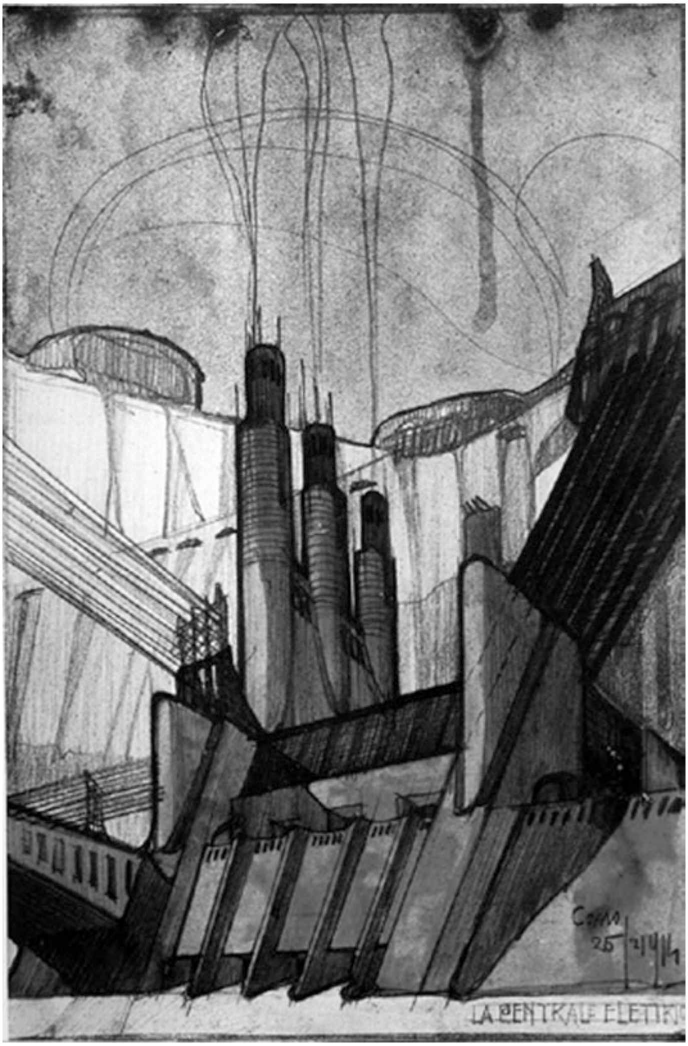


Fig. 1 Sant' Elia. *Power station, from the series New City*. 1914

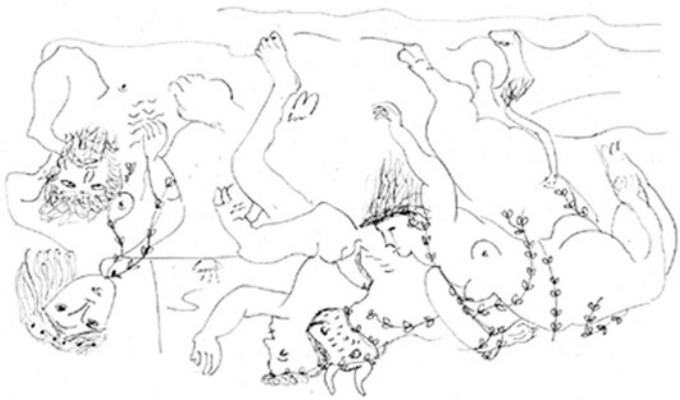
The purpose of essay is in fact the study of this process based on the work developed by students of the Master's Degree in Architecture from the University of Zaragoza, on the subjects of Architectural Graphic Expression, Architectural Drawing and Form Analysis. We aim to describe from our teaching experience how Edwards' theories can be verified through their work, as explained on Sant' Elia's drawing, and illustrate how the use of both brain hemispheres determines the overlapping of pairs: mirror/map and analog/digital.

As teachers, we are profoundly aware of the difficulties students face when enrolling for the first time in the graphic subjects composing the Architecture Degree and the fact that for most of them this is a new language. We also take into account that they have been part of a particular educational system mainly based on left-brain hemisphere related capacities, and we encourage them to explore a sort of knowledge based on the right one. Nevertheless, experience bears out that even when they have not yet developed these sort of capabilities, the training is as successful as on subjects related to the other hemisphere, such as language, mathematics or physics.

On the first day of school, students are asked to do a similar exercise to the one proposed by Edwards. Instead of Picasso's *Stravinsky's* portrait, we use another symbolic painting from the author: *Escultor en reposo y bacanal con toro* (Fig. 2).

Results are similar to what Edwards described. For those students without drawing experience, the quality of the work increases when copying from the inverted original, while for those already familiar with this discipline, the results are quite similar no matter what is the orientation. The exercise done by the student Manuel Cortes during the 2015–16 course falls into the first category (Figs. 3 and 4). The drawing copied from the rotated original clearly shows how the reproduction is an analogy of the whole, especially from the fact that he has managed to find the right proportion and position of the figures against the rest of elements. On the contrary, the drawing copied from the non-rotated original becomes less precise, probably because the student has tried this time to draw the image of every single perceived element, so the result comes from the mentally attached symbol instead of the overall captured form. In other words, the student has focused on getting a better definition of the figures and its

Fig. 2 Pablo Ruiz Picasso. *Escultor en reposo y bacanal con toro*. 1933



Figs. 3 and 4 Manuel Cortés. Copies of *Escultor en reposo y bacanal con toro* by Picasso, from inverted and right original. 2015

associated images independently, which is why the facial features of some of the characters are detailed and precise, but not aligned with the overall proportion.

When looking at the rotated original, students usually discover more because instead of looking at the element they want to reproduce, they just focus on the forms and the space around them. This reveals a shift in the way visual information is processed: from an analytic and verbal to a spatial and global system. The experiment therefore confirms Edwards' theory: the copied drawing increases in quality when the student is not influenced by his left-brain hemisphere and works instead with an analog language based on similarities.

From the perspective of the Gestalt principles, the inverted figure is naturally reinterpreted in the light of tones, relating both to the whole and each of its components. Transforming what is perceived into something new becomes easier for the brain, since this process does not involve reasoning. In both drawings copied by the student, boundaries are well located and figures are distinguished from the background, so we can say that elements have been grouped by similarity or continuity. In the case of the copy drawn from the non-rotated original, the processing becomes coherent and tends to increase the definition of the figures at the expense of the global awareness, while on the drawing reproduced from the rotated source the analog copy is consistent.

As the course progresses and the students become proficient at drawing, other exercises based on studies and interpretation of architectural spaces are proposed. In this case the students not only develop technical capabilities on the analysis of form and function but a poetic approach adding a sense of suggestion. From the actual location of the spaces they are asked to analyze, we encourage students to use both a digital language (code used from the map) and an analog language (diagram seen from the mirror), so each of them must find the right balance between those. Two significant samples of this exercise are the Delicias Train Station drawing in Zaragoza done by Javier Blasco (2012–13, Fig. 5) and the Aragón Library drawing by the Sofía Castiello (2011–12, Fig. 6).

The first one (Fig. 5) was done from a unitary and synthetic analysis of both surroundings, space, function and matter. Starting from the big space enclosed by the roof of the station, the student synthetized a series of key elements defining the building in a way that other details such as the context within the city or the technical complexity of the roof were also easily depicted. These aspects were not conceived by similarity but through an organic analogy, using codes. The result is a demarcated space that keeps the right perspective and direction, so we can understand both the location and the shape of the building. The synthetic way all these aspects have been implicitly treated also recalls a sense of speed through the space, adding a subjective component related to time.

Time also becomes a key element on the second exercise (Fig. 6), where movement flows were analyzed in a public building: a library. In this drawing, the

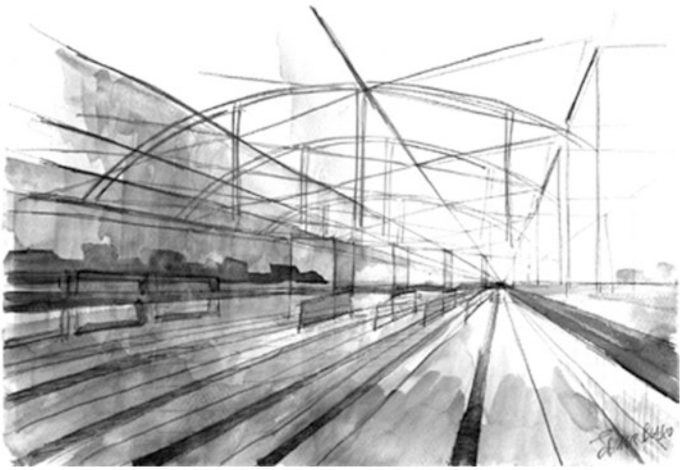


Fig. 5 Javier Blasco. *Delicias train station in Zaragoza*. 2013

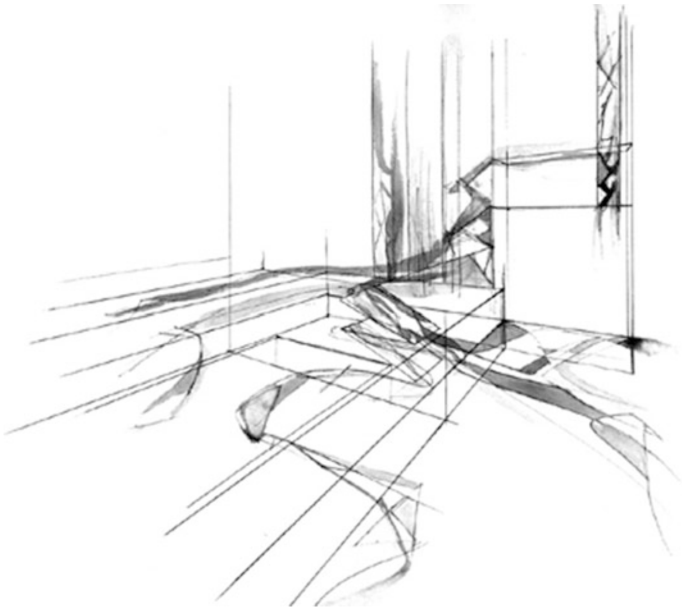


Fig. 6 Sofía Castiello. Aragón library in Zaragoza. 2012

volumetric definition of space is reduced to the minimum, keeping only the precise number of lines enclosing the circulation flows. Space was reproduced here through an aesthetic analogy, highlighting just the motion inside the building. Appropriate and precise diagrams simultaneously represent all circulations in a highly subjective way. The fluidity of the twisting strokes was materialized with a strong poetic presence, and this is why they become a key element of the composition.

We can conclude that both works were therefore significant abstraction exercises where the students had chosen different elements considered essential to synthetize precise aspects. The balance between the rational side of the drawing, related to the left-brain hemisphere, and the poetic approach, related to the right one, was achieved in both cases through different techniques. The first drawing (Fig. 5) highlights a digital component and its code, close to a constructivist way of communication while the second one (Fig. 6) is determined by an opposite pair, an analog component and its diagram, related to an idealistic way of interpretation.

Through the graphic exercises developed by the students, we have been able to validate Edwards' theories during the first phase of learning as well as Gombrich and Deleuze's theories during the second phase. Understanding the mechanisms encouraging our brain to master drawing techniques during the first learning phases we have been able to implement a consistent didactic system through the course, becoming especially useful for those students with difficulties. In addition, understanding the balance between the narrative and expressive drawing components during later stages we have found useful methods for analytical space representation that students will require in other subjects and will be valuable design tools in more advanced courses.

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Bologna Process and Web 2.0. A Free Software Based Assessment and Management System for the Art Studio Course Graphic Outcome

Iván Pajares Sánchez

Abstract This paper outlines a free software based system that enables periodical gathering, selection and grading of the Drawing, Analysis and Ideation art studio course graphic outcome for the 1st year level in architecture; it also tackles the methodology of circulating the graphic selections made, intended as a feedback system among the course group. The proposed system belongs to a social learning strategy through the use of blog(s) and *Dropbox* as an online repository of the class production. It is consistent with other experiences that discuss the integration of web 2.0 tools and self learning frameworks, but it is specifically focused on the needs of studio workshops and their graphic production.

Keywords Social learning · Cloud computing · Design studio

1 Introduction

The Drawing, Analysis and Ideation (DAI) course, which I participate in teaching along with Pedro Burgaleta (Senior Lecturer) and Fernando Lancho, aims for a constructivist pedagogy, where students learn from their own, as well as their peers work. For this strategy to work, apprentices must be surrounded by a display of their graphic productions and the feedback resulting from it; a crucial matter that reinforces our approach. For the duration of the term, the workshop walls showcase the graphic outcome of the course group: *the wall of fame* (Doorley et al. 2012, 48).

The flip side to this is the virtual realm, where a space of exchange and reflection is created, based on a number of Web 2.0 tools (Abad Gómez 2012); here, *the wall of fame* can be found on the course blog, which is regularly updated with selected

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works, references, etc.…; this, we believe, can help the student's individual work outside the class environment[1] (Galán Muros 2011) as well as reinforcing our main goal, which is to keep the apprentices wired to the group's energy. The Web 2.0 tools that we use can prove useful as long as they help create up to date content, relevant and pertinent to the topics our course addresses.

In order for what I explained above to take effect, we have devised a workflow that collects the students graphic production and makes it accessible; in this way, we have integrated a set of free software based tools and processes within a system that gathers the apprentices work outcome, enabling continuous revision and assessment; it also allows for an efficient feedback strategy by circulating the curated work among the group.

Our work can be described as a social learning approach, based on blogs and Cloud file storage, in line with recent work related to Web 2.0 and self learning integration (Cochrane and Antonczak 2015; Lowenthal et al. 2009), more focused on the particularities of drawing studio workshops.

2 Divide and Conquer

With the implementation in 2010 of the new syllabus, we laid out a system to phase out the old and troublesome collection of portfolios in the form of paper and Cdrom, allowing for continuous assessment of student work[2] (the average production in a typical term amounts to 12,000 images or 6 GBytes of data by some 65 students).

The system envisaged should allow us to:

- Oversee and manage the students graphic outcome.
- Tune the group to the same wavelength in relation to the course topics.
- Help the coordination between the faculty with regards to assessment.
- Showcase the course production work and provide a feedback environment for the group.

The first point to tackle was: "how do we put it all into practice?". In our academic community *MOODLE*[3] is the standard online learning environment or platform; our first tests revealed that managing thousands of image files demanded a big effort out of us to download and organise the files for our collective assessment routine.[4]

[1]According to the ECTS workload of the Bologna Process.

[2]As it is also implied in the Bologna Process.

[3]*MOODLE* is a LCMS or Learning Content Management System. A web application designed to help manage online courses.

[4]*MOODLE* allows downloading all assignment files in a .zip file for offline review. In our case this is a continuous process and repetitive tasks like this are boring and prone to error.

We required the ability to group images, make selections, create families, compare them, etc. Such operations could be easily made with a visual image manager, but none was found to provide enough flexibility within *MOODLE* or as an external plugin. Our basic knowledge of PHP, HTML, etc., prevented us from thinking about developing such a tool on our own. In the end, it became obvious to us that we would always need to get the images out of *MOODLE* for assessment.

Following the *Divide and Conquer* approach, we broke down the problem into manageable tasks which could be dealt with specifically as follows:

- An easy workflow to regularly collect the images and make them accessible to the teaching staff: *Dropbox*, a Cloud based file repository[5]
- An online showcase for the work produced: The Course Blog[6]
- An online forum to connect all the class in an open and easy way: *Google Groups*[7]
- An image viewer and manager: *Google Picasa*[8]
- Tools that help manage the amount of images stored: scripts or "batch" files and free command-line utilities like *ImageMagick*[9]

Hence, to tie it all together, all apprentices must follow three requirements from day one:

- create a blog[10] as a portfolio (Esteve 2009).
- sign in the course group[11] to access the forum and the mail list that connects everyone involved.
- photograph everything produced, upload it to the group's online repository[12] and publish it online.

[5]"Anything you add to *Dropbox* will appear automatically on all of your computers, phones and even the Dropbox website—so you can access your stuff from anywhere". There are open source alternatives like *Owncloud,* but they require a dedicated linux server, our dedication and budget contraints made us favour *Dropbox*.

[6]http://barrachunky.wordpress.com. active since 2010 in the ETSAM.

[7]http://groups.google.com. Online forum and mail list service that helps connect the group and share information. We are presently using the mail list capability only while testing the forum interface which we believe work better for our needs.

[8]http://www.google.com/intl/es/picasa/. Free image manager application.

[9]http://www.imagemagick.org/. Open source image manipulation and processing toolkit (as defined in UNIX jargon). Being command-line based, it facilitates integration with custom scripts or programs.

[10]There are many free services available like W*ordpress, Blogger,* etc. Students are free to choose the one that best suits their needs.

[11]We presently have a reasonable sign up process working, using online forms with http://www.jotform.com/. We have also used *Google Docs* (https://www.google.es/intl/es/forms/about/) in the past.

[12]Mobile phone cameras are sufficiently good, so this requisite is not a problem. Suitable breaks are staged during the class to photograph the work.

3 The System

The faculty members share a *Dropbox* account with enough storage space[13] to handle the data load of the term. A folder structure is generated by custom scripts[14] every quarter. The folders are automatically named after each student and uploaded to *Dropbox* (Fig. 1).

Apprentices can only access the folder in the central repository that they have been invited to. Course teachers, however, are able to access and manage all the folders. This creates a Cloud based shared file system.

A working *Dropbox* account and its associated client app must be installed on the student's computer. Once registered, everyone is sent an email with a link to one's shared folder. This way the apprentice puts his day's images into the corresponding folder in his computer and the files are uploaded to the Cloud. All the image folders synchronised in *Dropbox* are also copied to the teacher's computers.

Finally the system includes a personal blog open to the public that everyone attending the course must keep updated. The uploaded work is then visible for peer review and feedback[15] (Buxton 2007, 153).

4 The Database

Images are stored in a file-system based database, where each image is a file in the computer's file-system and not an entry in a database such as *Mysql*. As we were to be working with a distributed *Dropbox* storage system, this option seemed the most straight forward approach for effective shared access.

Our system then stores each image file within the aforementioned folder structure using a naming convention that sets the date and author of each image without the need to open the image viewer. Nowadays the template is: AAA-AAMMDD-NNN.jpg, where AAA stands for the authors initials, AAMMDD are YEAR MONTH DAY and NNN is the correlative number of the image in the days outcome,[16] implying a chronological ordering scheme.

The naming of image files following system requirements can be automated using *Picasa*, with the apprentice having online videos available in the course blog illustrating the procedure.[17] Access to video tutorials neatly separates individual

[13]We currently have around 20 Gbytes of space thanks to the years of use and the extra storage granted by inviting new users to the service.

[14]By "programs" in the context of this paper, we mean command-line batch scripts, or Python programs.

[15]A list that links to each student blog is kept on the course blog every term.

[16]This way "Juan González García" would archive two sample images from past May the 8th as: JGG-150508-001.jpg and JGG150508-002.jpg.

[17]See https://barrachunky.wordpress.com/2015/09/17/6129/.

Fig. 1 Storage folder structure

technique learning from creative learning in class (Buxton 2007, 413; Lancho 2015).

A couple of weeks of breaking in and a few mails to the more obstinate users is usually enough to set the system in (Fig. 2).

Database maintenance is handled via scripts to minimise repetitive tasks that are prone to error. As an example, a regularly scheduled job checks that all images are in jpeg format and do not exceed the set size and resolution, automatically converting illegal items (proper values being 2400 pixel size in the longest dimension and 85% compression ratio). That same script also checks system permissions in the *Dropbox* folder to avoid synchronisation problems.[18]

A well structured naming template lets us easily single out and correct wrong files or folders, checking for inconsistencies with dates, names or initials, etc.

5 Graphical Management of the Image Library

Google Picasa, is the *gui* based application that we use to browse the image database. We find that it has two main virtues: 1st it is free, and 2nd it enables multi user shared access when paired with *Dropbox*. This last feature means that any of

[18]Using scripts to process sets of files is fast and easy if done orderly. Similar procedures performed with a tool such as *Adobe Photoshop,* would easily become repetitive and prone to error.

Fig. 2 Image conversion and re-sampling script

the faculty can highlight an image (or put a star on it in *Picasa's gui*[19] metaphor) and the rest of the team will see it in their local copy of *Picasa.* Starred images can be filtered within the application to create albums, or selections that other parties will also see; this way, all the instructors can work together to feed the blog with class material that is outstanding.

Another free tool we deem useful is *PicasaStarter.*[20] This app lets us work with more than one *Picasa* database, allowing for term or course separation (this is not possible in plain *Picasa*). The consolidation of the databases of the courses done so far is a work in progress, consisting of more than 150 Gbytes of image data.

Semantic database queries are possible by means of image tagging in *Picasa*. It is also possible to automate image tagging with external programs (done with scripting[21]), since tags are metadata that *Picasa* can recognise. Image metadata (Ames and Naaman 2007) lets us create families of related images such as: by technique (water based, dry) or by theme (Piranesi, prisons).

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[19]*GUI*: graphical user interface.

[20]See https://sites.google.com/site/picasastartersite/home.

[21]Such as *ExifTool*. http://www.sno.phy.queensu.ca/~phil/exiftool/.

6 Future Work and Improvement

We intend to redesign the present system by integrating the tools with a high level programming language (*Python*) in order to: develop better tools to control the visibility of assignments; management and input of image metadata; implementation of an external database (*Mysql* or *Postgresql*) for more elaborate queries using *SQL* (Figs. 3 and 4).

A client-server approach using an external database would improve multiuser access and would have the added benefit of easing the development of independent *gui* based clients to tag and classify the image files in families. We are presently researching the viability of developing a client in *Python* using an open source graphic library such as *Pyprocessing*[22] or *Pygame.*[23] We believe this would help us engage the apprentices with tagging and organizing the database (Ames and Naaman 2007), which is right now the faculty responsibility only (top down). We think that a bottom up approach would enhance the usefulness of the system and the information retrieved from it.

Another positive by-product of the client-server model is the possibility of integration with other frameworks like *MOODLE* via its *API.*[24]

All apprentices should be able to see their colleagues work (Lowenthal and Thomas 2010) to avoid the limited innovation capability of closed groups, compared to those that share knowledge outside its limits (Abad Gómez 2012); this is an actual limitation of our system (Buxton 2007, 164), where the work produced is at times disconnected or somewhat isolated. The personal blog model may be too enclosed and does not involve students as desired (Moreno Marquina 2015); it may be that a system more akin to social networks, where the entire group's material is available for review or comment, would work better.

This pitfall raises the issue of assignment visibility when students upload their production through *Dropbox* without publishing it for their peers to see, or without making it to the selection published on the course's blog. At the workshop, as previously explained, work is visible to everyone and outstanding work is on display on *the wall of fame*. This matter has come to light with the general

[22]See http://py.processing.org/. It is a port of Casey Reas and Ben Fry *Processing* (a flexible software sketchbook and a language for learning how to code within the context of the visual arts) to *Python*.

[23]See http://www.pygame.org/hifi.html. *Python* library to ease the creation of games and *GUI* tools in *Python*.

[24]Application Programming Interface. This is a set of defined functions and methods for interfacing with the underlying operating system or another program or service running on the computer.

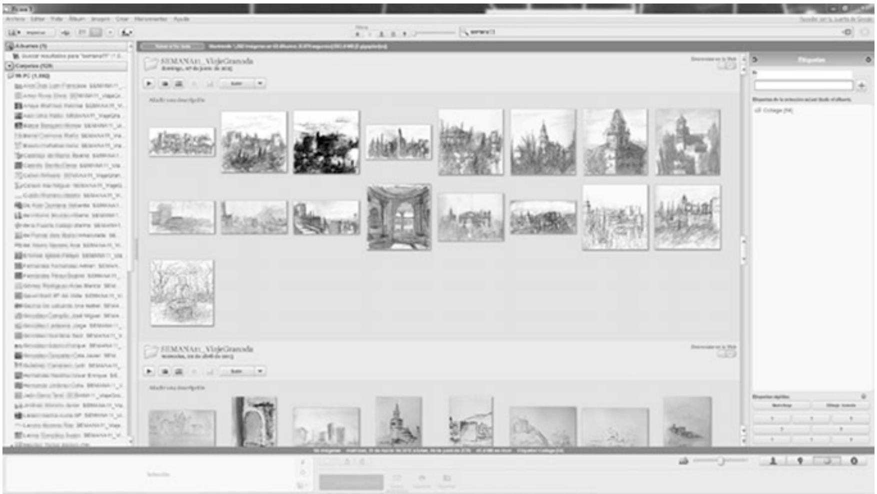

Fig. 3 Picasa, images filtered by week

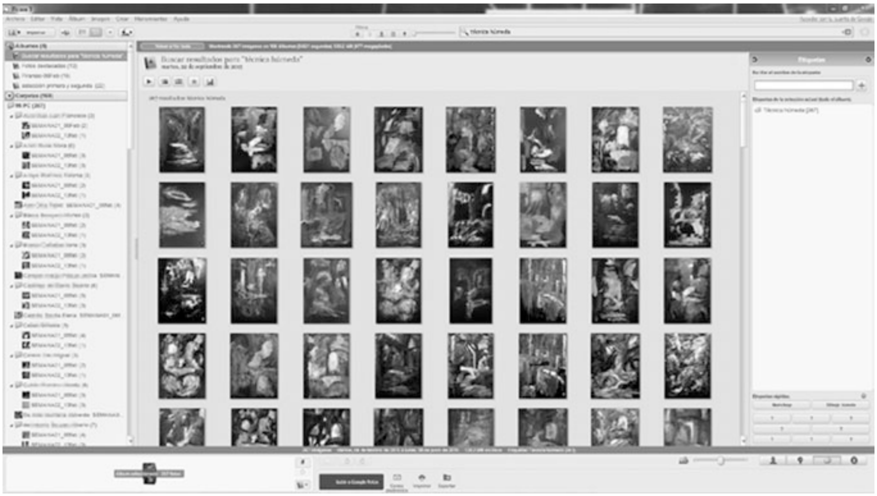

Fig. 4 *Picasa*, tag based query

availability of *MOOC*[25]; online platforms like *Coursera*[26] enforce peer revision, should one wish to be graded.[27]

[25]Massive Open Online Courses.

[26]See https://www.coursera.org/.

[27]A difficult line of work in art related disciplines like ours, where objective assessment parameters are somewhat difficult to define.

Moreover, the present federated blog approach works fine on a day to day basis during the course, but later browsing of the archive is sometimes problematic (if not impossible because of students removing their blogs after the course completion).

Some of the more appealing benefits of "public" assignments are (Lowenthal y Thomas 2010):

- Apprentices check their work against their peers and identify the best to learn from (Ames and Naaman 2007).
- There have been cases of plagiarism in the past, mainly because the apprentice felt his/her work was subpar. "Public" display avoids this, because everyone can see everybody else's work and identify any copycats.

7 Conclusion

Traditionally in the ETS of Architecture of Madrid, the grading of student graphic work was done by browsing through notebooks and drawings laid out on the classroom floor. The problem with this approach is that grading becomes a sequential pass through of the work, normally in chronological order, where comparisons—especially between different students—can prove difficult; such a grading process would solely rely on the teacher's memory to process the student graphic production as a whole.

We believe that the system based on database queries that we support allows for an improved process to filter and review student's graphic work, whereby we can see all images of a particular assignment together, or under the same technique or theme, thereby creating further connections or relations within the works.

Good work is quickly singled out using thanks to the comparative panoramic view that is enabled by our methodology, reinforcing the flexibility of our system versus others like *MOODLE*.

We insist on changing sequential grading of course production. The premise that a trained eye can quickly discerns good material on an image matrix is what we strive to work towards!; as a result, by avoiding the shuffling of folders and portfolios, it turns grading into a pleasurable experience, a fact that must not be neglected, as it affects both teachers and students. Ultimately, we are grading the students learning and productive competence, as much as our own, so we are able to propose relevant issues well adapted to learning goals.

It may sound trivial to acknowledge that the grading and evaluation process, where the entire course faculty gather together, works much better through the use of a projector. Grading on a laptop screen can never do justice to the images; fortunately however, projectors are now standard equipment in educational institutions.

We believe an easier review process positively affects the apprentice: they have the opportunity to observe the continuous evaluation of their own work, as well as the opportunity to learn from the corrections made to their peers work; in this way,

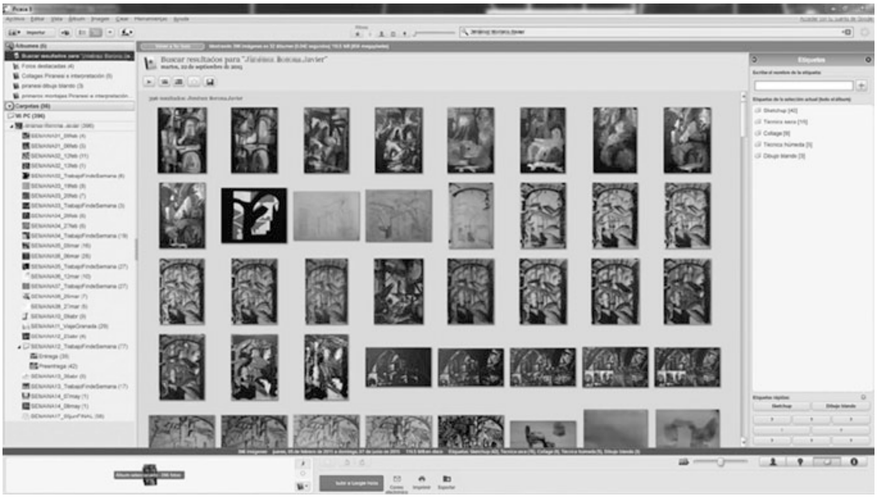

Fig. 5 Picasa, view of all images from a given apprentice

the continuous reviewing process does not rely only on fixed assignment dates and outstanding work is circulated in view of all on the wall of fame (either physically or virtually on the blog). Such publicity provides strong stimulus for an apprentice, for prestige inter pares can usually be a much stronger motivation than any other (Torvalds and Diamond 2002, 240), let's not forget that (Fig. 5).

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Drawing of Carlo Scarpa's Villa Ottolenghi

Alfonso Ippolito, Cristiana Bartolomei and Carlo Bianchini

Abstract There has always existed an inextricable interrelation between architecture and drawing. On the other hand it is obvious that architecture can manifest itself as an expressive literary form (studies of treatises, etc.) as a construction (i.e. as realized usable spaces, etc.) or precisely as drawing (i.e. as a thought-form expressed through signs). Starting from these points the research traces—through historical interpretation, critical analysis and the use of informatics utilizing virtualization as an element of representation—the development of the design idea and the construction of Carlo Scarpa's Casa Ottolenghi.

Keywords Casa Ottolenghi · 2D-3D models · Carlo Scarpa

The research enquires—through historical reinterpretation, critical analysis and the use of informatics utilizing virtualization as an element of representation, exactly as was the case with the design idea and the construction of the Villa Ottolenghi, the work of Carlo Scarpa. The enquiry—developed within the study courses at the Department of Architecture of the University of Rome "La Sapienza" and the Drawing of Architecture 1 at the Department of Engineering of Bologna University—is based on the idea to compare the unique results achieved by students who attended two different courses of study.

Carlo Scarpa, and above all his Villa Ottolenghi, were chosen for the research mainly because there are no extant final drawings, but only a considerable number of drawing and sketches. Thus the idea was born to make students interpret and

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reconstruct architecture through 2D and 3D models. The choice of Carlo Scarpa was also dictated by the fact that "drawing" had been the leitmotif of his work.

The experimental value and originality of the results are inextricably linked to the integrated and varied approach adopted by the students of both courses of study.

Provided for students of the first year course at Bologna were basic drawings, mostly sketches, available also in Web sites. They were requested to reproduce a drawing—with a rule and a setsquare—of the unique details of construction and of its whole with the view to stressing the role of "drawing" in the formation process of an engineer-architect.

The starting point of the 2nd year course was the two dimensional basic drawings elaborated by the Bologna students. The experiment was conducted to find out to what extent drawing could be controlled—reasonably enough—by informatics modelling.

Thanks to this procedure the student could compare drawings and sketches with the model to arrive at considerations upon which to reconstruct the design and formative progress of Scarpa himself.

The formative progress of Carlo Scarpa initiated in 1926 when he presented his Diploma of professorship in architectural drawing in Venice. Since then drawing had been the spirit of his work. Not only once did he define it to be the "door" through which one enters the world of architecture.

Then he taught at the Istituto Superiore di Architettura di Venezia as assistant professor at the department of architecture chaired by Guido Crilli and later as professor of interior decoration and drawing from reality (Figs. 1, 2 and 3).

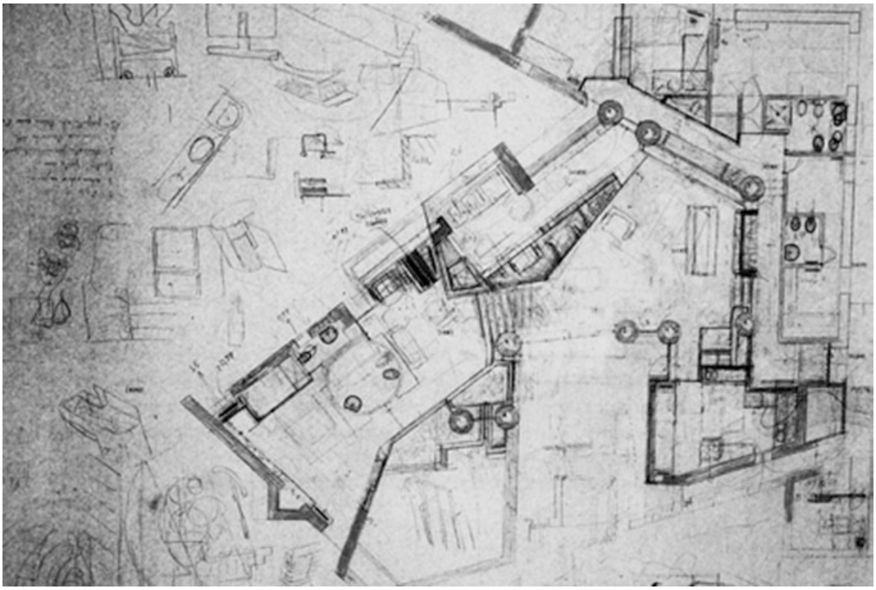

Fig. 1 Carlo Scarpa's drawings for the Villa Ottolenghi

Fig. 2 The complete work. Images of the outside

Fig. 3 The completed work. Images of the interior

The commission for the Villa Ottolenghi came in 1974 when Carlo Ottolenghi employed Carlo Scarpa to design a villa for his son Alberto in Bardolino on the Lake di Garda.

At that time Scarpa was already a well-known and respected architect, a remarkable assistant professor famous for having presented his designs at numerous Biennale of Architecture.

Yet Carlo Ottolenghi chose him knowing that the spirit of his designs was never the same, always open onto new design processes. The design of Villa Ottolenghi would finally concretize the concept of design "alla Scarpa".

Drawing applied with utmost rigor is certainly Carlo Scarpa's principal means of expression. Hence it seems easy to guess its importance for interpreting and understanding his designs.

Scarpa is an architect who designs a lot, often changing the scale, swinging dexterously from drawing of the general to drawing the particular, thus passing with ease form the scale of a high denominator to one of a low denominator. It is precisely these leaps of scale that make especially fascinating the Scarpian generative process of designing which manages to take into control almost maniacally each element of his design by integrating it in the total design. He used to say that he could only see an image when he drew it.

His design research develops through representation realized and formalized in a long sequence of drawings done in all necessary scales that compose the design process. His drawing is inextricably linked to the research project, as the two things cannot be separated. In fact for him drawing is neither a simple instrument for designing nor a Meta language. It becomes architecture itself.

His architectural—cultural references are invariably "thought out", totally "designed", detailed and original, just like the architecture of Hoffmann, items of interior decoration of Mackintosh, the paintings of Klimt. Carlo Scarpa forms his mentality of an architect studying the drawings of Frank Lloyd Wright, Tony Garnier and Alvar Aalto.

He contemplates each characteristic feature, each detail and each sign and arrives at the conclusion that for him drawing has a function not to be eliminated. He insists on elaborating details so much that they become the hub of his design matrix and treats them as basic elements from which to start the design of the whole work.

In his view there is no discontinuity between the creative act, in which the work is thought out, drawing and the realized form.

He draws innumerable sketches introducing innumerable variations and alterations – even when the changes ranged but a few millimetres. The body of his work can be classified into three categories: drawings of the context which allow him to remember ideas and designs; detailed studies on carton; transparent paper to continuously introduce variations.

Drawings for the Villa Ottolenghi—the last work realized by Carlo Scarpa, unfinished because of his premature death—reflect a sustained and consistent characteristic of an incomplete design and remain partly disconnected therefrom.

Yet this feature allows one to enquire into the significance and meaning of Scarpa's drawing, concentrating on the question how direct is the relation between drawing and design.

Even the last design of his—realized after his death on the basis of an incomplete body of drawings—reflects his striking artistic talent as well as his unique process of creation. The drawings contain all the peculiarities, which allow us to understand to what extent his drawings always express the way he achieved artistic and professional maturity.

The Villa Ottolenghi, therefore, presents itself as the synthesis and the manifesto of his manner of designing but especially of constructing architecture. Even though this construction was realized posthumously, it still remains the result of innumerable conceptual drawings, but—above all—of drawings of construction and details.

The corpus of authentic drawings, so fragmented and distant from final drawing, opened up for students the possibility to carry out research—through a historical-critical interpretation—that would allow them to select, recognize and evidence the focal points of his design method and also to perform a kind of experiment by applying the technologies of informatics modelling and compare original drawings with their own elaborations.

The rich variety of drawings offers the material to be considered the point of departure to understand the design research that inspired Scarpa. With this material and modern representation instruments it is possible to recognize and evidence the different stages of the designing process.

This particular feature furnishes an excellent basis upon which to develop didactic and formative means to introduce into the syllabuses of Architecture and Building Engineering.

Analyzing the graphic material provided by Scarpa it is impossible not to notice that this body of drawings and sketches become more and more linear, sober, gain a purity of treatment, especially when compared to villas designed before. One sees immediately how drawings of sections and perspectives were executed, precisely to demonstrate that the elevations prove to be but the natural consequence of what happens in the plan. There are no extant drawings with notes and corrections, although they are a characteristic feature of various coloured cartons of other designs. Yet it is evident that the designer of the Villa Ottolenghi was sure of what he was doing, that he did not get lost in the very pleasure of drawing but stopped only to make notes of measures and to make remarks regarding construction (Figs. 4, 5 and 6).

The design process for the Villa Ottolenghi can be traced through drawings where next to general plans there appear fundamental elements of the context, some of them stylized, others emphasized, still others completely left out.

Looking at the representations one immediately sees the influence of Frank Lloyd Wright's manner of drawing. His drawing is done on a piece of paper with a lapis pencil, the graphic representation of the design and of the context on which he insisted is devoid of important variations as regards the technique of the instruments used, as if he meant to express the continuity of the past and the future,

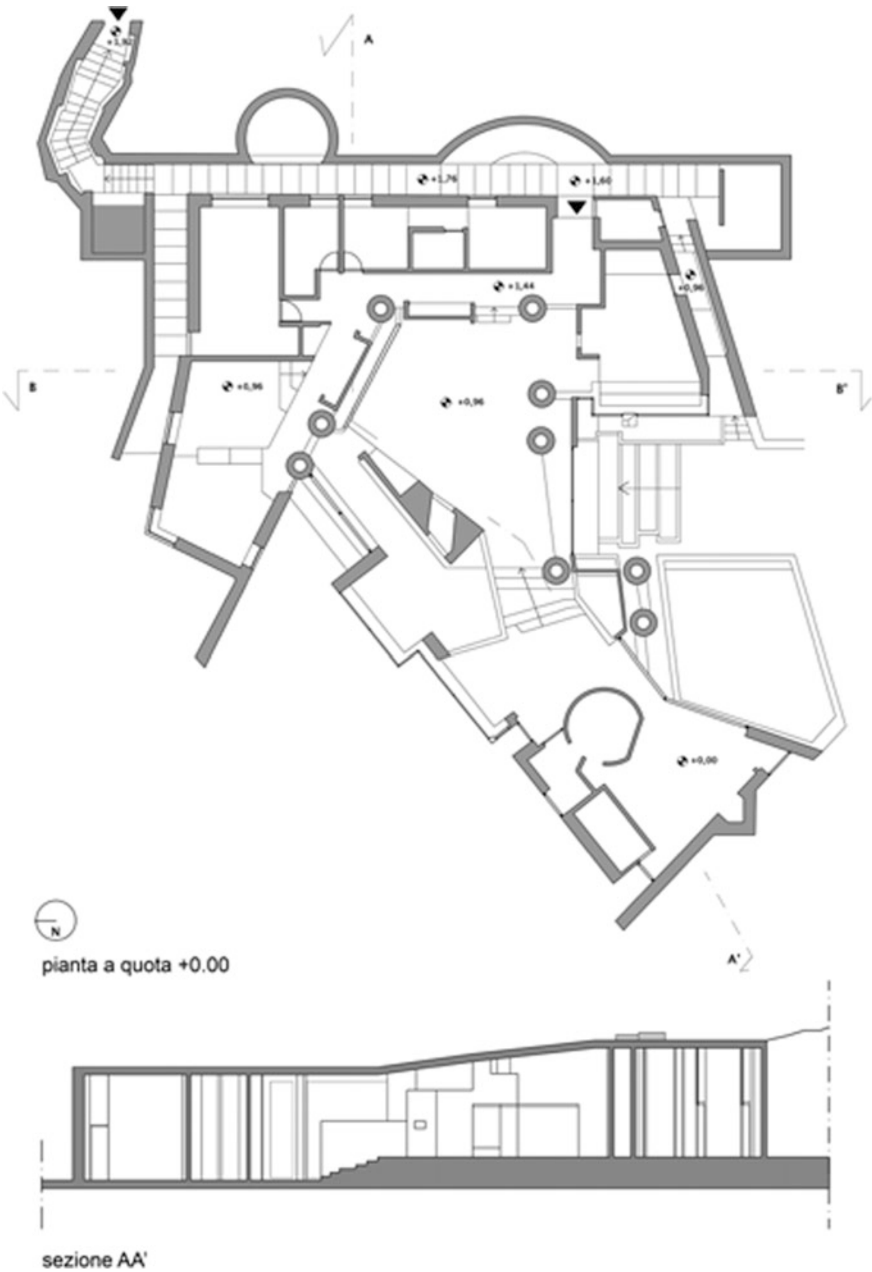

Fig. 4 2D models

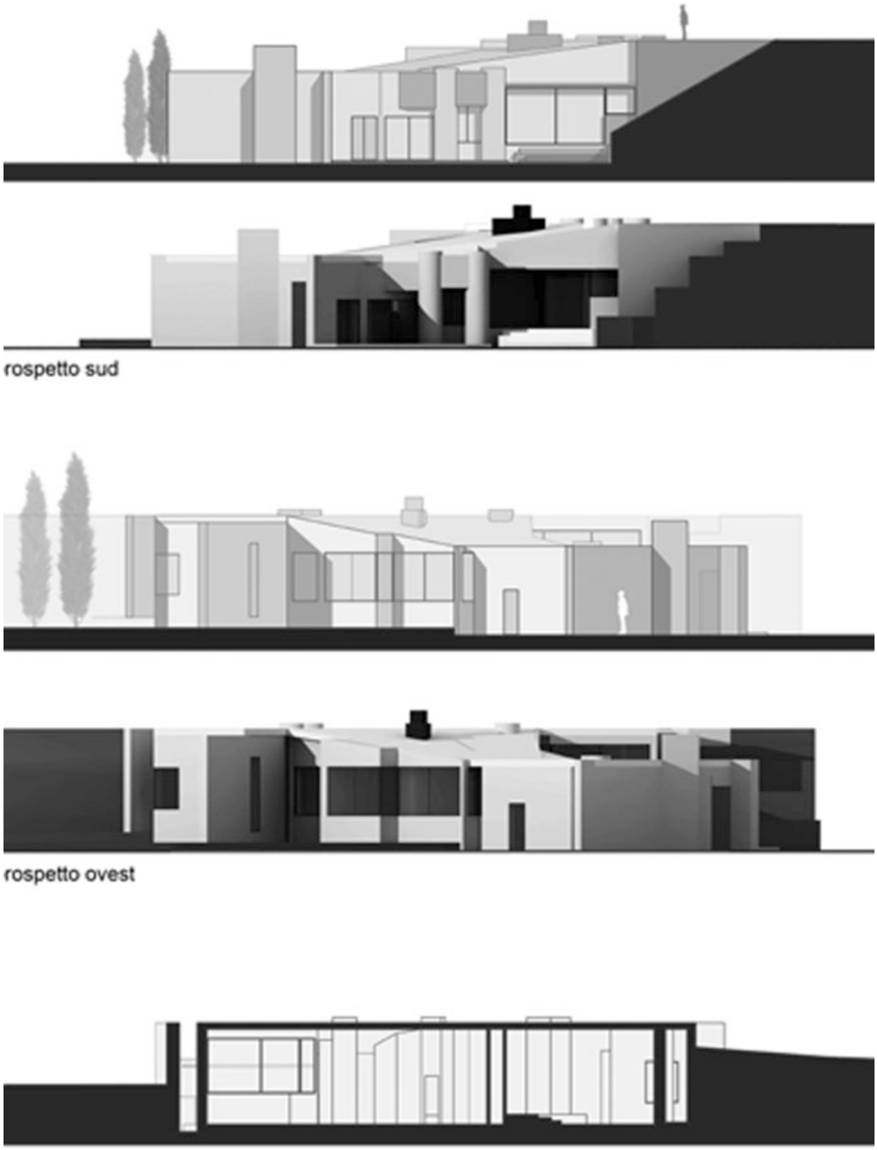

Fig. 5 2D/3D models

between what is new and what already exists. He often uses sketching paper for drawing the latest proposals and variations in order to place them over the first drawing. Observing the first drawings one notices that even though they are only first sketches, they show a completeness expressed principally in the systematization of basic elements of the design: the columns, the fireplace, the oval bathroom.

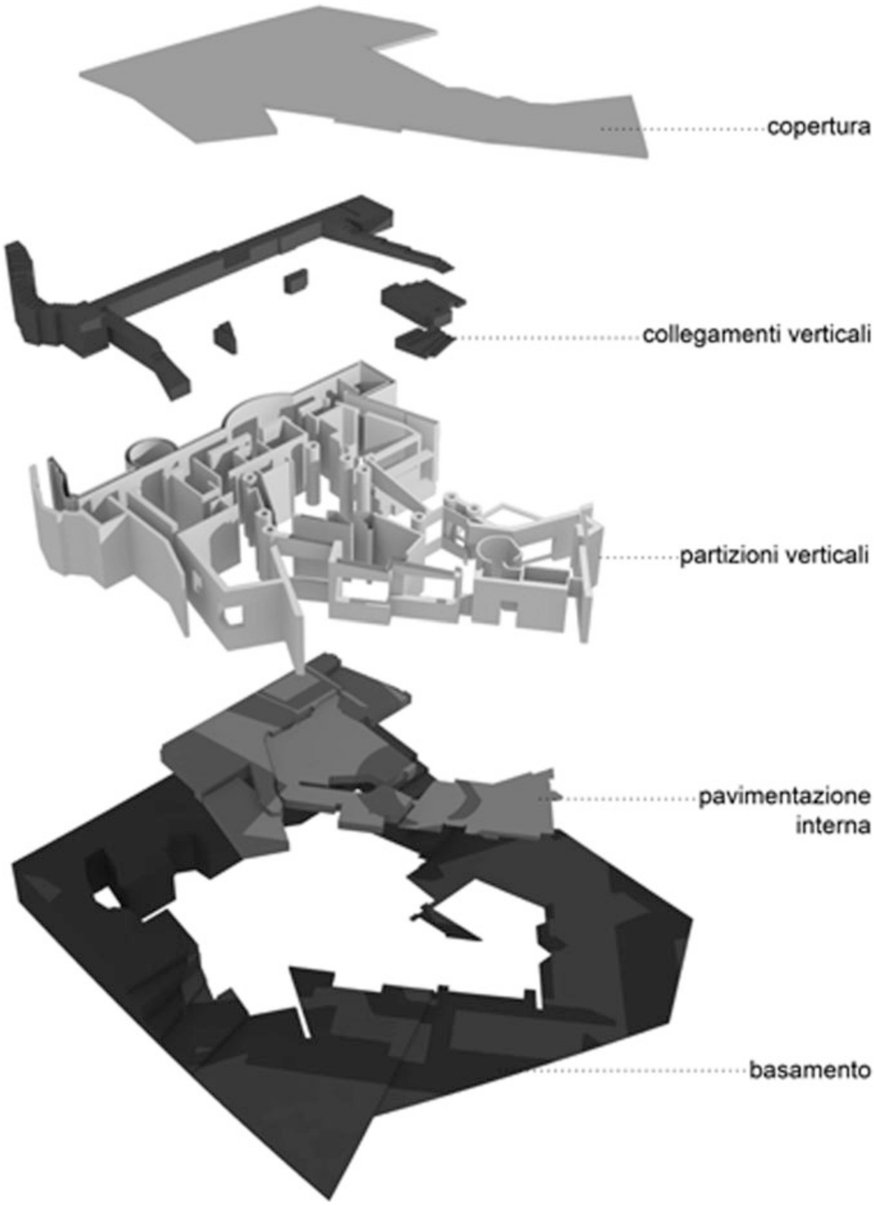

Fig. 6 Assonometric analysis

Not a single sign is erased, which makes us understand the stratification and the evolution of the design. The use of transparent paper—so characteristic of Scarpa—allows him to see the rejected ideas, to reintroduce them, adjust them, as he certainly did with the column design.

Columns were the first to be changed and altered in the drawings from three in the initial version, to nine in the final drawings, and four, seven and six in between. The considerable number of drawings and sketches of this detail show clearly the care and attention Scarpa devoted to it and where he sought inspiration. Certainly the columns do not conform to static requirements but only to formal ones and those concerning composition. They have neither base nor capitals and do not follow any rule of proportion that links diameter with the height of the stem. In the initial design the columns served the purpose to mark the entrance monumentally but successively they were definitely arranged—from six to seven—at the side of the entrance (Fig. 7).

The columns were changed and altered many times, contrary to the fireplace whose design was defined from the beginning. Its function was to divide the space portioned out for the living room, integrating objects of interior decoration, like the library and the bookcases.

The fireplace drawings are completely devoid of chromatic suggestions. It is strange for Scarpa's designs as he always devoted some attention to the selection of colours and materials.

The preliminary drawings of the oval bathroom look as if their form had been generated by the construction of two circumferences, which later are transformed

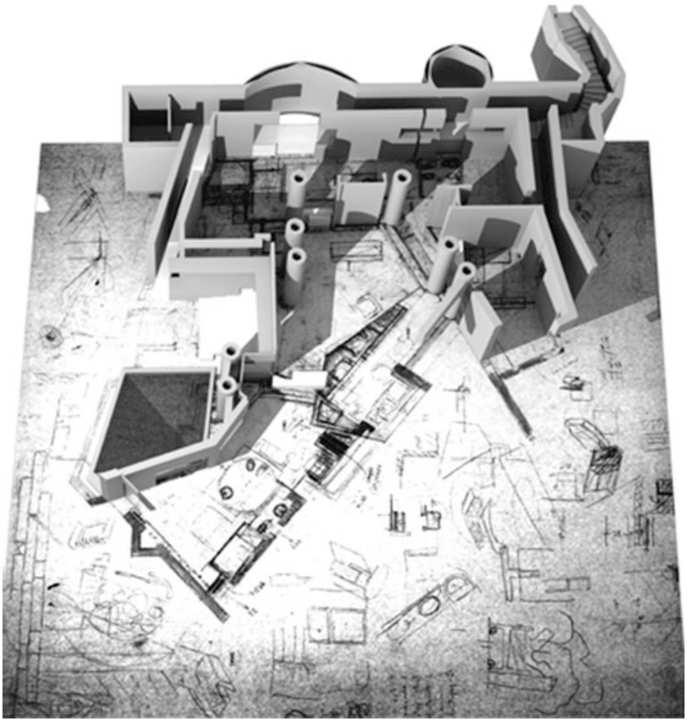

Fig. 7 From drawing to realized work

into ellipses with closer sides. In the final version the form turns out to be a part of the circumference.

The final designs were first approved by the Bardolino Community in June 1975, but in 1979 were modified and represented by Giuseppe Tomasi after Scarpa's demise. This is due to the fact that Scarpa used to introduce alterations to the design during its construction, so original final designs of the Villa Ottolenghi simply do not exist, even though the plans remain more of less the same as the initial ones, conforming to the building norms of the Bardolino community. At the death of Scarpa three different situations were to be confronted: the first one where there existed drawings containing precise indications as to the realization of the given element; the second one, where there existed study sketches devoid of any optimized solution of a given element; the third one—with elements for which there are no drawings at all (Fig. 8).

Certainly the initial design idea that inspired Scarpa was related to urbanistic problems and the limitations imposed on the height of the house. To avoid the restrictions Scarpa decided to bury a considerable part of the villa underground. In this way the whole volume of the building was hidden from the observer's eye and its unusual form integrated into the surrounding terrain. Light and air enter the house through a kind of "calletta"—distantly resembling the calle di Venice. It separates the volume of the construction from the ground floor of the back support. Yet the most striking feature that meets the eye immediately is the covering of the house created by joining inclined plans. They produce effects of perspective, which change with the point of observation.

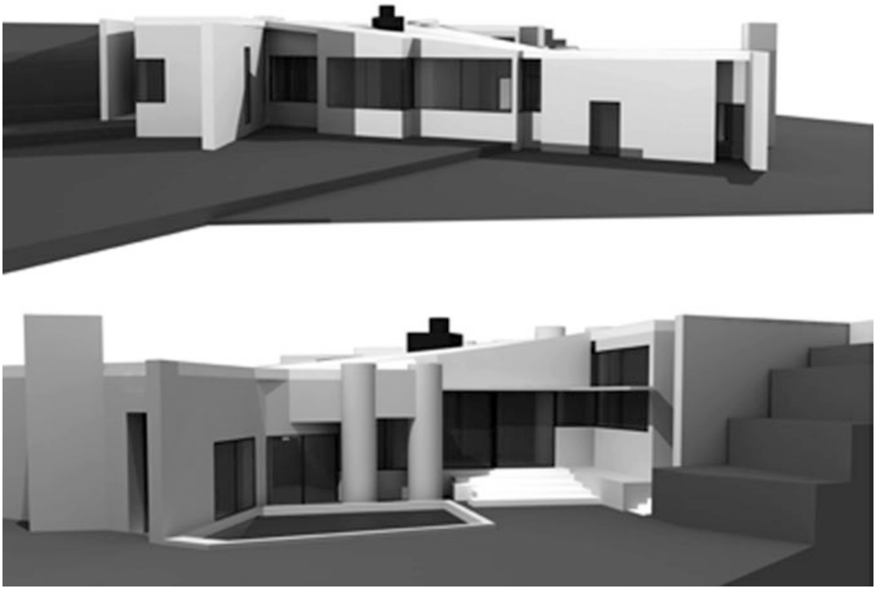

Fig. 8 3D models

At the first contact with the drawings of the Villa Ottolenghi, neither a single prospect nor a volume is visible. Maybe that is why Scarpa executed just a few drawings of the ALZATI but the view of his intervention into the terrain where in correspondence with the tangent lines of the inclined planes of the layers and at the extreme points emerge five of the nine circular columns which surround the living room and support the roof covering the house.

All this became the source of the students' enquiry and research, but before they could elaborate their drawings, they had to understand the design idea of the whole villa (Fig. 9).

The study and tracing back the construction process with modelling software that led to the construction of various 3D models of the villa and its context, made it possible to understand much deeply the development of Carlo Scarpa's design idea and its elaboration. In order to create three-dimensional models it was unavoidable to superimpose the plans on the drawing of details, continuously comparing them, which is only possible within the CAD environment. It is well known that for each of his design iter he focused a lot on details. Hence a great number of drawings of locks or system of opening doors and windows. Let us note however that Scarpa never glorified details. On the contrary, he regarded them as equally important as

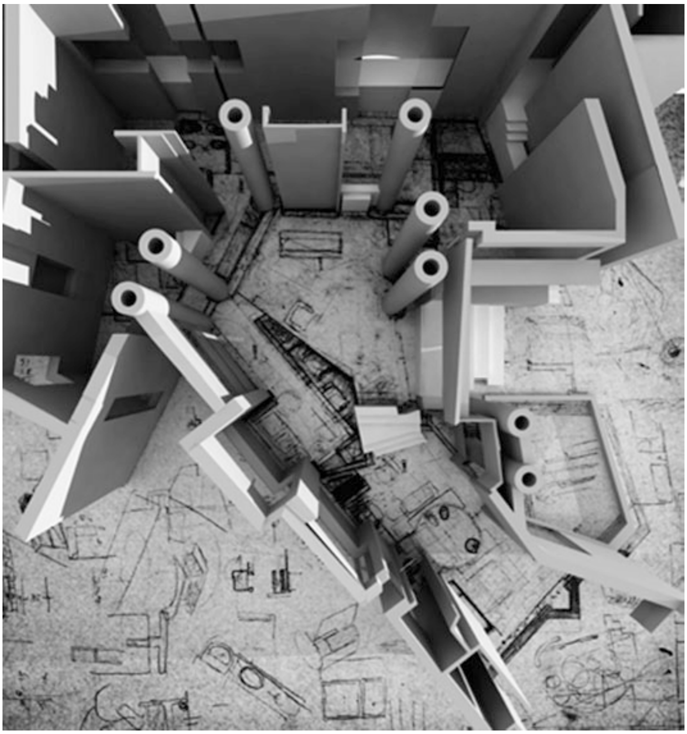

Fig. 9 3D models

the whole work and rejected any hierarchy between the whole and the detail: *each drawing has its own value and equal importance*.

The extensive series of drawings of locks shows that Scarpa did not consider them only as elements serving the purpose of screening and closing spaces but as a complex machinery capable of regulating the relations between the outside and the inside. They define internal space in relation to the external context of the house. Once again Scarpa's genius expresses itself in evaluating the whole context in relation to the functional form of a mere lock.

Hence it becomes clear how the Villa Ottolenghi becomes architecture that can be traced virtually, physically and visually inside 2D and 3D modellers. This aspect has never been part of any course of drawing. Scarpa's representation of the Villa Ottolenghi appears almost transparent: it seems that what is drawn are not the walls but all that "is there", inside them, with colours marking different superimposed planes.

The study of Scarpa's drawings must take into consideration the graphic techniques he applies. He loved lapis pencil and carbon paper but did not despise pastels or crayons. The first versions of his elaborations were sketched on sketching paper with carbon paper. With the ideas becoming more and more definitive he tended to use the lapis pen. Apart from these, he also applied, transparent paper and tissue paper in order to be able to continuously introduce even minute alterations to the drawing he had finished. Among his representation methods are sketches with perspectival and assonometric views he drew because they made it possible for him to convincingly enquire into the relation between architecture and the site, fundamental for the design proposal for the Villa Ottolenghi. Yet he never neglects plan studies. They show the elaborate process of designing. They appear in great numbers on the sides of innumerable sketches, later becoming germs of successive detail drawings. Basically, from the point of view of representation his methods progress parallel to each other and on each table we can find – besides the main drawing of a plan, for example, numerous other drawings represented with methods different from the orthogonal designs. The arrangement scheme for a table always remains the same that Scarpa used to apply, also in the Villa Ottolenghi: in the center of the table, in central position, there is usually the plan, surrounded by sketches, represented with different methods, which sometimes serve to underline, but at times to contradict what was made explicit in the central drawing. Then he elaborated deeper the problem of scale: the same sketches that represent the basic nuclei of architecture are drawn in the proper scale on sketching paper where for each detail different scales represent variations on the subject. Each detail serves to verify the whole. He never represents isolated details but only different levels of studying the problem.

All in all Scarpa's drawing clearly show that the basis of the Villa Ottolenghi architecture—just like of all his works—prove to be figurative. Each element is created first as representation and only later it is ascribed a function. In Scarpa's designs form always comes before function, which is expressed by form.

In our view this is part of the fundamental knowledge students of architecture and building engineering have to absorb and understand. It is precisely where a remarkable originality in teaching drawing can be found: only purifying and metabolizing this aspect can lead to progress of knowledge, as the drawings proposed seem to demonstrate.

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The Sketch as an Approach to the Observation of Human Acts in Initial Architectural Training

Rodrigo Lagos Vergara, Jorge Harris Jorquera and Claudio Araneda Gutiérrez

Abstract The course "Foundations of Architecture" consists of a phenomenological/experiential approach, through drawing, to the different kingdoms that make up our sensory world: mineral, vegetal, animal and what we—following Juan Borchers—call "humanal" kingdom. Attempting to perceive what surround us without prejudgments allows the exercise to guide the students reflections from the beginning towards awareness of the fact that architecture is not given (nature) but rather, a man made object (social). In doing so, it reveals human acts to be the architect's object of study and observation itself as a first means of approximation to it.

Keywords Drawing · Observation · Acts

1 Architectural Observation

Observation is commonly understood as the experience of seeing, noticing and watching attentively and cautiously, of looking and examining in detail. This experience is, from the point of view of research, an empirical procedure by excellence: the most primitive and widely used. It is through this procedure that a concrete and intensive relationship is established between the researcher and the social act or social actors, and where the researcher makes distinctions (1): data are obtained that are later synthesised to develop the research and create knowledge. For architecture, a discipline that requires research and knowledge for its

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development, understanding observation is fundamental. According to Harris and Morgado (2004)—following Cruz (2002, 2005)—architecture, in an essential definition, is the expression of a spatial order qualified to house all the acts of human beings. This relationship between act and space is the essence of the former and the key concern of this discipline. Its comprehension is the basis for the creation of the architectural and design proposal expressed in the form of a project (2). In order to achieve this comprehension, the use of Architectural Observation is fundamental. This observation is carried out through a sketch (3) and annotations in the spaces where acts take place, establishing evidence enough to look into this comprehension.

From a graphic point of view, the sketch technique, which must be accomplished in a short time as only a few lines are necessary to identify the object observed, requires a trained eye for its execution. For architecture, the observation through the sketch is the attention needed to see, understand, and learn the reality we have to live and the place where we have to act. In this attention, the being—from the mind, the eye, and the hand—manifests itself grasping the motion and the event. In this sense, the sketch, unlike the drawing, is more static, it grasps the qualities of interest whether they are sequences and concatenations as physical supports of movement or actions of the body. For Harris, observation sees the requirement of creativity anywhere, any time. Thus, it always tries to build a measure: the measure of a limit of human habitation. Such habitation goes through perpetual renovation according to civilisations and periods (Harris 2000).

Training students in observation from the beginning is important in the teaching of project. It is about developing the capacity to distinguish, from among all the objects that populate the sensory world, human acts as the object of study proper of an architect in the search for the idea that supports the foundation in a first architectural invention or creation stage. For Harris and Morgado (2014), the invention or creation is about the search for the idea that supports the foundation of the project, that emerges in a first instance from intuition to be developed later more consciously (4). In order to generate the "idea" or "image" of the project, an attention operation must be carried out that, for the development of discourse, can only be achieved through observation. From the beginning, it is an "image" and not a concept as some claim, because only this is able to generate the invention or creation proposal as it somehow brings a measure—or a very close approximation to the measure—unlike a concept, which has no measure.

The exercises that we show below are a first approach to observation in order to reach the comprehension of the act-space relationship, prior to the experience of observation as such, which the students will apply in more detail in the architecture workshop.

2 Course Description

Foundations of Architecture 1 is a first year course where the students exercise the phenomenological observation method through the study of human acts as source of architectural knowledge. The students are expected to learn the phenomenological observation in order to cognitively empower themselves through the study of objects representative of the kingdoms of the sensory world; to distinguish human beings, from among all the objects that populate the sensory world, as the object of study proper of an architect in order to obtain and create architectural knowledge and to apply human acts analysis strategies in order to extract and communicate such knowledge (5). The first five lessons of the course contain the essence of the pedagogical and didactic proposal oriented towards the first two objectives. The first lesson is a practical introduction—as well as didactic and tactic—to the paradigm of phenomenology. The students face a series of objects they have never seen before, that is, experiences they have never gone through. This allows us to get a first idea of the habitual cognitive state in which we are once we finish secondary education: that is to say, of relative blindness (Zajonc 1995). It is thus taken that the cognitive activity performed more actively is not to perceive the world around us but to systematically place first conventions/prejudices/words. This clarifies abruptly that we do not perceive the world for what it is but for what we were told it is at home and in school, and incidentally, for we so often are, victims of our own education. The next four lessons are, in fact, four contemplative exercises about the world of the given. We begin with the contemplation of an object representative of the mineral kingdom, followed by one of the vegetable, animal, and "humanal" worlds, respectively. Each object is surrounded by a perfect circle and during the first half of the lesson, all the students record by means of a sketch, paper and pencil, in silence, what they observe.

In the second half of each lesson, we perform a thorough characterisation of each object captured, extracting a brief manifest from each one. Bellow we show four edited examples of each lesson made up of graphic and written records by students with a summary of the corresponding comparative analysis from each one of them (Figs. 1 and 2).

3 Characterisation and Results

From the beginning, the didactic strategy makes the students—in Schon's terms (1992)—to "reflect on the action" spontaneously orienting themselves towards a more or less clear idea, of which neither the mineral, vegetable, or animal kingdoms are objects of study proper of the architect. Based on the understanding that architecture does not belong the world of the given (natural world) but to the world of what is made by human beings (social world), the humanal kingdom emerges as the sole sound candidate for object of study properly architectural and, following

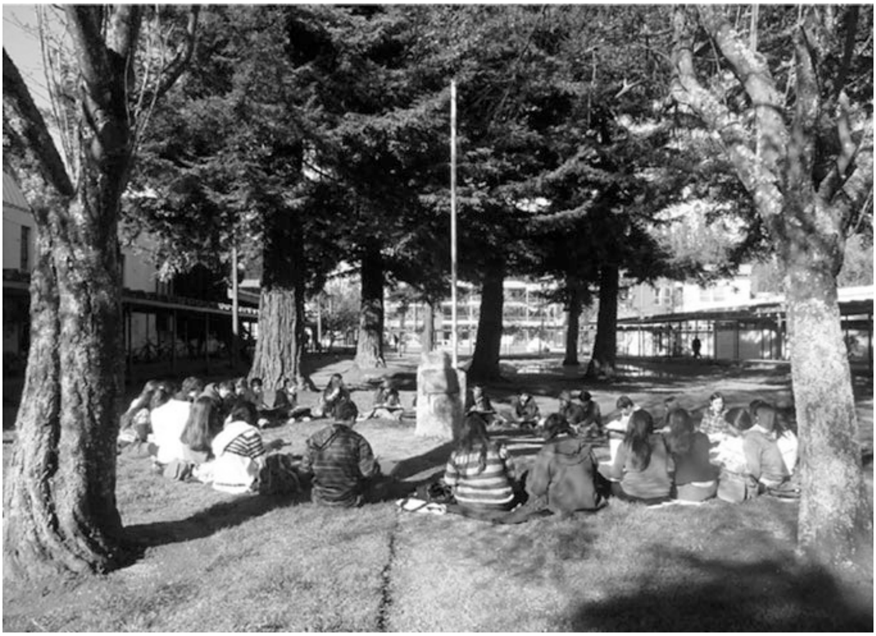

Fig. 1 The students take position in a circle, facing the object to be observed in the centre, at a distance that allows them to have full view of the object from different angles

Borchers (1968), the one responsible for the creation of the order called artificial on the face of the earth, though all the kingdoms are included as existences that constitute the human activity and, therefore, architecture (Fig. 3).

At this point, however, common sense warns, immediately, that this is the object of study proper of all properly human discipline. Thus arises the second great question with which we later begin the second part of the course: What from the humanal world is object of study proper of the architect? Here emerge what we call "archetypical acts", namely: getting up/going to bed, walking/stopping, sitting down/standing up, finding/losing. The human body takes shape in the act. No particular inhabitant or client but, firstly, the human being is in constant need of a dwelling (6).

Having begun to distinguish an object of study proper of an architect from among all the objects that populate the sensory world, the practical challenge is to develop analysis strategies relevant to the object under study. It so happens that this object is, so to speak, a kind of target in constant movement, which poses methodological, technical, and technological challenges that are part of the next stages in the course. These, however, are out of the scope of this article (Figs. 4, 5 and 6).

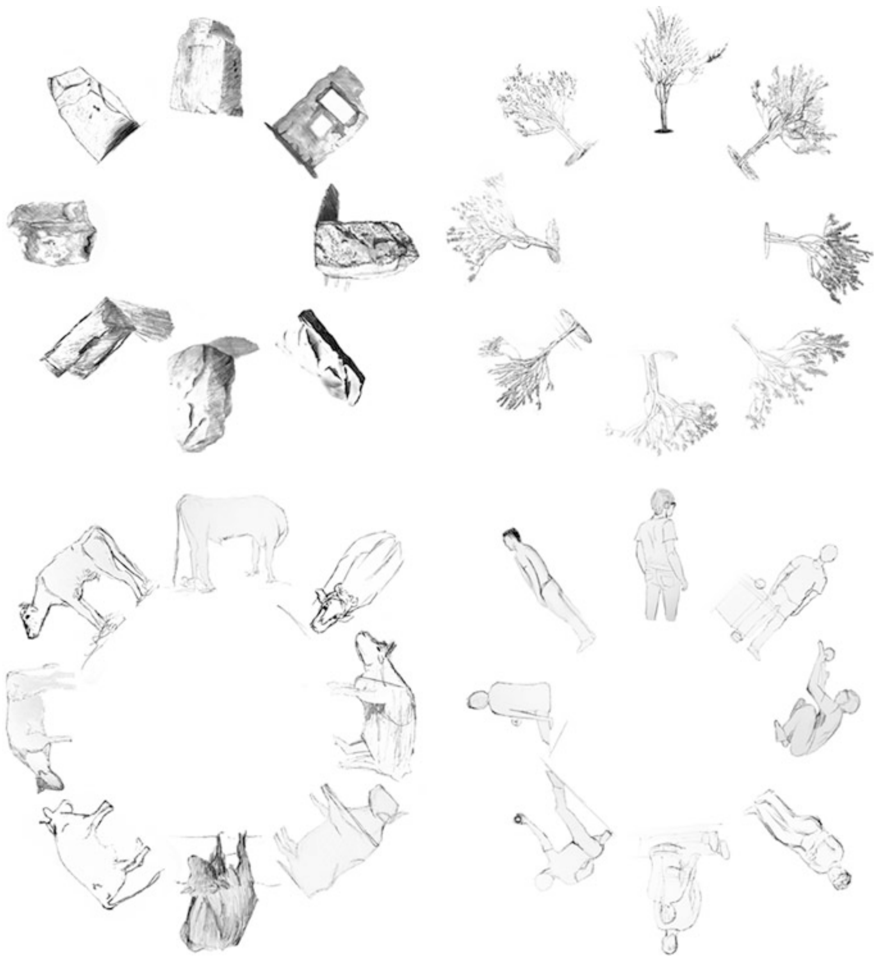

Fig. 2 The graphic records edited show what has been observed by the students, from the different angles (works carried out during the second semester of 2014)

Fig. 3 Collective graphic characterisation of an object representative of the mineral kingdom. The comparative analysis shows that in this kingdom there is no apparent life, at least possible changes do not occur within the time frame of observation, where a "deep sleep" state prevails and no movement manifests (works carried out during the second semester of 2015)

Fig. 4 Collective graphic characterisation of an object representative of the vegetable kingdom. The comparative analysis shows small movements that announce changes and life, that is, an innate tendency to movement and growth (works carried out during the second semester of 2015)

Fig. 5 Collective graphic characterisation of an object representative of the animal kingdom. The comparative analysis shows this kingdom as animate—where the movements of the object challenge the expertise of the observer—predictably and intrinsically whole in its environment (works carried out during the second semester of 2015)

Fig. 6 Collective graphic characterisation of an object representative of the "humanal" kingdom. The comparative analysis shows this kingdom as animate and—though the movements lead to acts in the exact measure as the result of a learnt experience and of memory—unpredictably and intrinsically incomplete in its environment (works carried out during the second semester of 2015)

Notes

1. We talk about "distinctions" following Maturana and Varela, since all observers, though they might think they are losing their minds, only see what their schemas of distinction allow them to see and they cannot see what their schemas of distinction hide from them (Maturana and Varela 1984)
2. Regarding the act-space relationship, and observation as an approach to knowledge and the teaching of architecture, we take as a basis the works of Alberto Cruz C. and the School and Institute of Architecture of the Pontifical Catholic University of Valparaiso. These experiences, passed on from teacher to student and then written down on work documents published by the same school, had much influence in Chile from the '70s onwards, particularly in places such as Universidad del Bio Bio founded at the time (Lagos 2013). From the '90s onwards, numerous articles in journals and international exhibitions show the works by Cruz and the teachers of the school, being among the most recent ones that by Beatriz Colominas in the exhibition "Radical Pedagogies" at the Venice Biennale, 2014: "Alberto Cruz, Godofredo Iommi, Claudio Girola. Escuela e Instituto de Arquitectura PUCV, 1959–1972" (González 2014).
3. We could understand that the sketch (from the French verb *croquer*: chew, eat, outline) as the elaboration of a first freehand draft, sketch or diagram intended to graphically represent an idea or image. The sketch is a graphic expression that quickly synthesises an idea, observation or problem. For architecture, the sketch is used to capture a reality and, in turn, to make proposals on it. That is why the sketch is present in all stages of a work, from the selection of its variables, the observation of the site where it will be built, and the peculiarities of the schedule required, to the first conceptions of the project, the quick revision of alternatives and its material and construction conception. At the proposal stage, and in spite of the various digital visualisation tools currently available, the sketch still implies a recency and immediacy that is appealing and properly lays the possibilities of the project.
4. An approach to the teaching of architecture and design in the workshops, considering the work as a discourse, it would be made up of three key aspects: invention or creation, disposition, and manner. The disposition deals with the search for and adoption of a general plan that allows ordering and developing the "idea" or "image" that is to be argued. This general plan is aimed at the whole and not the parts, as it is the whole that sets the order of the parts. Concepts such as 'model' or 'type' show that geometry is fundamental at this disposition stage, just as it will be to solve the project in a reality constructed to become a work, since architecture is a constructed reality, and then it is used and inhabited by the human being. The manner deals with the personal characteristics through which the architect can ensure the eloquence of the discourse. More than ascertaining facts and collecting information about the reality, only through observation there can be a constant search for this manner in the different projects to be developed, understood as a state of the being, and as something that belong to that being.

5. The School of Architecture of Universidad del Bio Bio intends to develop in the students, during the first year, the abilities of: architectural observation, in the sense of creating a rupture that leads them to adapt everyday looking; and of proposal of a new architectural spatial order for a given act, in a real context and from their personal approach; of logically understanding the design process and the capacity to propose and create new spaces for a given act. http://ubiobio.cl/arquitectura/.
6. The study of the "archetypical inhabitant" or the protophenomenon notion (Araneda 2010) reconnects us, in an updated manner, with the phenomenon of creation in the properly artistic sense (Seamon and Zajonc 1998).

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From the Old World to the New. Experiences of Teaching Geometry in Peru

Ana Cristina Lavilla Iribarren

Abstract Architecture born in Piura in 2013, integrated into the Faculty of Engineering. It aims to achieve academic excellence in the northern region of Peru, forming architects who have a solid humanistic base and an adequate training to intervene in the city, without neglecting the other aspects of the profession. The Communication aims to analyze the educational experience of the first year of the studies, particularly in the teaching of Descriptive Geometry, highlighting the innovative techniques applied, the challenges overcome to address the lack of specific preparation of the student and the necessity of geometrical knowledge for the effective management of drawing software and a sample of the final level achieved by the students.

Keywords Teaching geometry · Innovation · Peru

In 2013, due to a strategic decision taken by the University, Architecture became a degree course in Piura and was integrated into the School of Engineering as an Academic Program. The aim is to achieve academic excellence in the northern region of Peru by educating architects who have a solid humanistic base and suitable training to be involved in the city, but without ignoring other facets of the profession. Consequently, from the very first meetings of the Faculty Advisory Council, the decision was taken to promote two aspects in the training of architects:

– Command of the skills needed for spatial representation: architectural drawing and descriptive geometry, together with specific training in the use of software.
– In-depth knowledge of the urban setting, in relation with the complexity of human life and sociology.

Therefore, teaching geometry to the future architects is a key educational objective whose aim must be the proper depiction of space. Through the perception of shapes and the need to create and transform our world, human beings have

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attempted to explain what we perceive by means of our senses. For humans, geometry is the international language for the description and transmission of what we perceive for other members of the human race (Vargas and Gamboa Araya 2013). In fact, geometry allows for the development of such competences as knowledge of communication, of depiction, of modeling and re-interpreting the results of this embodiment of the images. These skills permit work on the major concepts, for example, growth, space, shape, dependency, relations and reasoning … (Alsina 2000), which are at the foundations of modern architecture.

In fact, since the 20th century, architecture has been considered mainly for its spatial content, and therefore, it is essential to be capable of two-dimensional and precise three-dimensional depiction. An in-depth study of geometry allows for the command and development of the prior process of intellectual control of that which is to be depicted. Consequently, it must not be taken as a mere technical instrument but rather as a basis for the development of spatial imagination and the creative process of the architectural project.

This paper aims to analyze the teaching experience of the first year this degree has existed, more precisely the teaching of the subject of Descriptive Geometry, by underlining the innovative techniques applied, the challenges that have been overcome to offset the students' lack of specific preparation and the confirmation of the need for knowledge of geometry for the effective use of computer drawing programs. The teaching of Architecture, although subject to constant revision, must always take into account the global challenges of the profession without losing its own specific nature. In this sense, the workshops, which give real experience to the student and the professor, are the main pedagogical focus of the studies, and lectures are reduced to the minimum in order to favor active methodologies.

We thus propose to share our experience in the creation of a new School of Architecture in a desert region with high poverty levels, far from the classic models for the teaching of this profession, but always based on the Western tradition in order to achieve the necessary innovation to train professionals who will assist in the progress of a developing country.

1 Teaching Geometry at the Pre-university Level

Before focusing on the development of the geometry taught in architecture, we must offer a panoramic perspective of teaching in Peru, more specifically referring to issues of drawing. Secondary education is organized into cycles: the first, which is general for all pupils, last two years and, together with primary education, makes up the block of obligatory education; the second, three-year cycle, is diversified, with scientific-humanistic and technical options. Two models are on offer: for adolescents (aged between 12 and 16) and for adults. There is then no high school diploma which prepares the students specifically for access to higher studies and they begin the university at the early age of 16. We also face the low level of teaching in most Peruvian schools, which do not offer their students a level which is high enough to access university studies, much less a degree in architecture, as they show a serious lack of specific knowledge regarding technical drawing, plastic techniques and history of art.

The different curricula of the technical branch of secondary studies do not include any technical drawing or geometry courses, and what little is taught in the subject of mathematics concentrates on the memorization of concepts without going into their practical application. For example, the pre-university students can theoretically define geometric points such as the incenter, circumcenter or centroid, but do not understand their implication in the inscription and circumscription of circumferences or in the physical concept of the centre of mass. Further, most of them have never used drawing instruments to sketch angle bisectors or perpendicular bisectors.

From this perspective, the secondary school teacher is the main actor, while the students are mere receptors of information, which impedes their interiorization of the knowledge through the practical reconstruction and use of this knowledge.

2 Geometry in the Academic Program of Architecture at the Universidad de Piura

The Academic Program of Architecture is a program of study which is carried out over five years divided into semesters (two semesters per year). Each academic year has been assigned a certain number of credits depending on its complexity; the sum of these credits at the end of the degree (graduation) must add up to 220 credits. Those students who have been accepted for Architecture must do a preparatory or introductory course, in order to have the necessary skills to carry out their studies successfully. This course consists of obligatory Basic Drawing (Fig. 1).

Architecture shares several courses with the initial phase of basic science for Civil Engineering, which is complemented with the area of Architectural Graphic Expression. In the first two semesters of the degree, this area includes Descriptive Geometry 1 and 2, together with Architectural Drawing 1 and 2, and in the following years is completed with various courses on Projects. The Geometry subjects aim to give the students greater knowledge of the systems of spatial representation and their relationships with the procedures for graphic and visual expression of the different phases of architectural design. All of this is done so that the students will, in combination with the subject of Architectural Drawing, have sufficient skills for graphic conception, taken as the skill or capacity to conceive and represent the shape, color, texture and luminosity of objects and to have command of proportions and the proper drawing techniques to transmit the essential formal elements at each stage of the process of planning and design.

Moreover, the teaching of geometry in the first year is completed with an optative course on AutoCAD Basics, given by professors from the area of architectural graphic expression, which permits access to the following cycle.

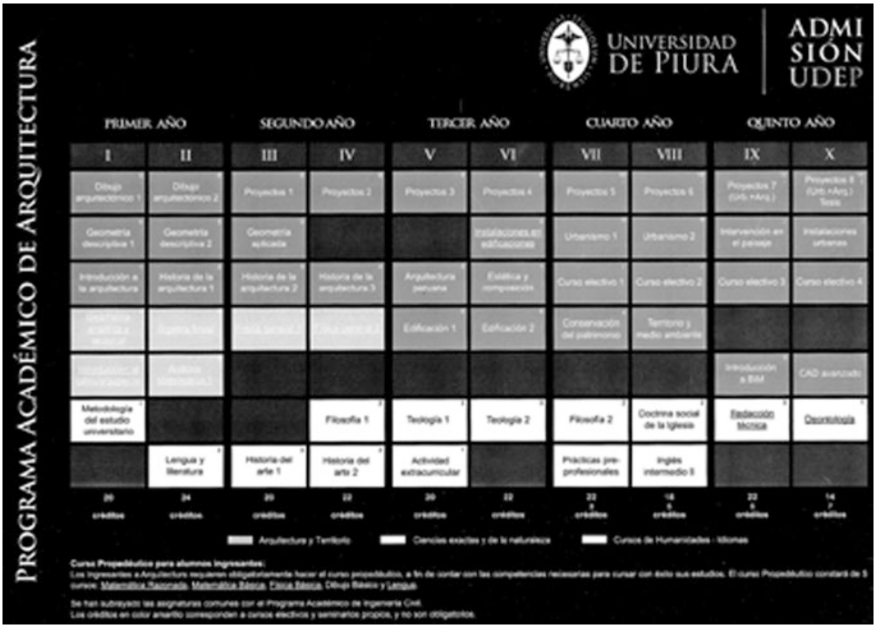

Fig. 1 Curriculum of the Architecture Academic Program of the University of Piura

3 Levels of Teaching of Geometry in UDEP Architecture

Before structuring the different geometry subjects that are given in Architecture, we had to ask ourselves what level of knowledge should the student have when he/she finished the first academic year of the degree and began to deal with the conception of projects, in accordance with his/her prior knowledge and the demands of the modern world and the reality of Peru. As we have pointed out, the students start university with much less grounding in geometry than students in Spain. Moreover, the local architects' capacity for the geometric conception of settings and buildings leaves a lot to be desired.

After analyzing the previous points, a model by levels (based on Van Hiele1 and Piaget2 models for geometric reasoning) has been selected. This allows us to assess students' progress in geometric reasoning, while simultaneously assisting the professor in the organization of the contents of the different courses in order to achieve effective learning. The success of the levels system is based on the use of resources and sequentiality: the results of one level depend on how well the student has assimilated the strategies of the previous level, and he/she cannot go on to the next level without having been successful in the lower ones. In addition, each level is associated with a specific type of language for representation.

The following are the levels of teaching for the subjects established for Geometry in UDEP Architecture.

Level 1: Recognition. Real-world objects that we wish to know, understand and represent are identified. The student begins to produce copies of each element, the descriptions are mainly visual and recognize determining properties such as parallelism and perpendicularity, although he/she are not yet able to explain these properties.
Level 2: Analysis. The student begins to represent three-dimensional objects through systems of abstract representation. He/she is able to imagine views of elements although they are not physically present. He/she establishes the properties of figures through experimentation and manipulation, but cannot make definitions.
Level 3: Deduction. The student defines the elements by their properties and recognizes how some properties draw from others. At level 2, the students could not understand that some properties derived from others, but they can do so at this level. She/he can handle the relationships between properties in such a way that she/he understands that one can find the same result following different procedures. He/she recognizes the need to justify and demonstrate the steps followed in resolving an exercise.
Level 4: Order. For the first time the student confronts the problem of creating a three-dimensional space without a basis in experimentation. She/he understands the rules that govern descriptive geometry and begins to use them in a reliable way. The student is capable of linking sequences of exercises which are resolved in different dimensions (2D-3D) in order to find the answer to the proposed formulation. To reach this level, a high degree of abstract reasoning is needed in order to achieve a global vision of the objectives of the exercise.
Level 5: Manipulation. The student is prepared for the two-dimensional representation of complex three-dimensional objects, beginning with ever more refined formulations. She/he can manipulate spatial relationships in order to obtain the desired results. She/he comprehends the consistency, independence and completeness of the foundations of the representation system. The aim of the student is not merely solving the exercise, but rather the rigor and precision involved in implementing the solution.

4 Phases of Application of the Levels System in the Teaching of Geometry in UDEP Architecture

Teaching levels were our guide in designing and organizing the correct learning experiences for the students in order to move from one level to the next. Throughout their training in Geometry, no one phase excludes the others; rather, at the beginning of each subject, the student must have the knowledge acquired in the previous phase. We shall now give details of the practical application of these levels in the different Geometry subjects taught in the first cycles of the Architecture degree.

Drawing 0. In this subject which, as has already been pointed out, does not belong to the degree course itself but rather to the preparatory course which must be taken in order to enroll in the First Course, the students who have recently left school come in contact with the new object of study. There are six hours per week, divided into two hours of theory and four of practice. The professor must identify the prior knowledge the students may have (which is usually non-existent or extremely basic) and their level of reasoning and capacity for abstraction. The students receive information in order to get to know the field of study they are about to begin, the methods and materials they will be using, etc.

This phase covers levels 1 and 2 (recognition and analysis). Firstly, the student is confronted with the identification of elements which give shape to objects (silhouette, parallel and perpendicular straight lines, fitting, proportion) in an intuitive way through the conic system, but without theoretically explaining the rules that govern it. To do so they begin with freehand drawing of rectangular prisms with later extrapolation to drawings of buildings and areas by means of reduction of the object to prismatic volumes.

After this, the axonometric system and flat views of pieces are introduced. For the progress to be gradual, to start with students represent floors, elevations and profiles based on physical models constructed in cardboard. When they understand the relationship between the real model and the orthogonal perspectives, they are asked to reconstruct the piece using isometric representation based on its flat views. Finally, the students must be capable of completing the views of a body from two views only and, simultaneously, be able to draw it axonometrically.

The systems of representation used at these first two levels are rectangular prisms and axonometric projection. The rectangular prism system was chosen as an early introduction to geometry as it is the most similar to human eyesight and, therefore, the most intuitive in simple exercises to represent the reality that surrounds us. In addition, the axonometric projection system is easy to use and has the advantage of allowing for the measurement of distances on a real scale, and so is very practical when teaching students about proportions.

The role of the professor is fundamental in this phase, as he/she must select suitable activities to allow the student to learn the basic concepts and properties for this new level of reasoning and spark the students' interest in learning geometry. In addition, for better understanding of this level by the student, the problems proposed must lead directly to practical results which the students must comprehend and learn. Reality is placed at the service of geometry and not the other way round. In the educational field we should be particularly sensitive to restricting the geometric reality to cases of interest for the students (Figs. 2 and 3).

Descriptive Geometry 1. This is a five-credit subject, that is to say, five hours class per week, divided into two hours of theory and three hours of practice. The subject has two sections or blocks, the first on flat and spatial Metric Geometry, and the second on the dihedral system of representation. During this phase the students must learn to use suitable technical language to describe the characteristics and relationships on which they have been working. At this level there is new learning and revision of what has been learnt previously.

Fig. 2 Drawing 0 students working on fitting

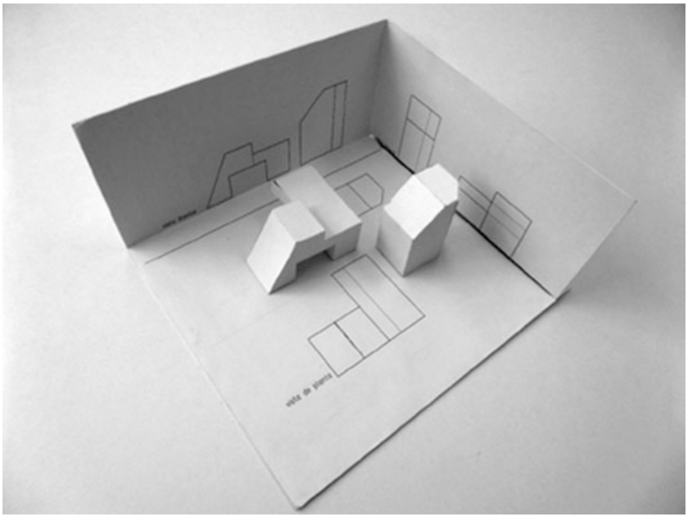

Fig. 3 An example of a cardboard model for flat view learning

The first block of the subject begins with the verbalization of the students' prior knowledge. The student must attempt to express, both verbally and in writing, the relationships and properties of polygons that he/she already knows. Later, their knowledge of flat geometry will be broadened with proportionality, similarity, equality and tangency. The block ends with an introduction to the metric geometry of space, paying particular attention to reasoning in solving generic spatial exercises which will later be applied in any system of representation (drawing of planes from points in straight lines, measurement of angles and distances between different elements, parallelism and perpendicularity between straight lines and planes, the theorem of the three perpendiculars, etc.).

The second block is made up of an introduction to the dihedral system of representation. We decided to concentrate our efforts on the teaching of this system as, to date, it is the system most frequently used by architects when sketching their projects and because the conic system, taught with methodological rigor, is extremely tiresome and, in the profession, has been substituted by the elaboration of views using computer programs.

The dihedral system allows the students to reach the level of abstract thinking and spatial vision needed to complete this level of training, and, at the same time, the relative simplicity of the norms and rules which govern it guarantee the possibility of its in-depth study in the short last time we have available. In the time spent on the theory, the foundations of the dihedral system (point, straight line, plane, parallelism, perpendicularity, and distances) are explained and will allow the students to be comfortable with it when it comes to representing any element whatsoever. The objective of these explanations is not merely that the student should learn to apply a series of procedures which lead him/her to solve an exercise, rather he/she should understand the reasoning and the spatial comprehension of the reason for these procedures.

For the students to be fully aware of the characteristics and relationships they have learnt, and to consolidate the technical vocabulary, apart from solving the exercises, they must discuss and comment on how the exercises must be resolved and on the elements, properties and relationships used. To do so, apart from the practical workshop under the supervision of the professors, the students must solve problems to be handed in the following class, and they are advised to work in small groups; this has produced excellent results (Fig. 4).

Descriptive Geometry 2. This subject is taught during the second semester of the first academic year of the degree and has fewer credits (3) than the first one. Consequently, there is a reduction in teaching hours to three per week, divided into one hours' theory and two of practice. This phase does not produce learning of new knowledge but rather a consolidation of the work carried out in the previous phases, which results in consolidation of the new network of knowledge which is being formed. The students must use the knowledge acquired to work out more complex activities and problems. These exercises are not a simple direct application of data or a procedure, but deal with new relationships with broader approaches and several processes of resolution. The professor must limit his help to the students as much as possible, as they themselves have to find the most suitable process based on what they have learnt in previous phases.

Fig. 4 Descriptive geometry students studying the characteristics of regular polyhedrons in models which they themselves have made

Fig. 5 Descriptive geometry 2 students discussing the resolution of practical work in the workshop

As can be seen, at each level teaching task is organized based on workshop dynamics (prevalence of practical hours over theoretical ones), arranged as follows (Fig. 5):

– An introduction to the topic so that the students understand. In the lecture room the basic concepts of the topic to be dealt with are explained together with the objectives, in order to give a framework to the actions to be carried out.

- A presentation of the exercise to be done, in which the students are prompted to observe, explain and express conjectures and to discover relationships about the concept.
- Execution and resolution of the exercise in the workshop. Discussion and comparison in small groups so as to communicate the different approaches.
- Execution of extended and amplified problems.

Course on AutoCAD Basics. These students' training in geometry is completed with a computer course on drawing, which is given simultaneously with Descriptive Geometry 2. After earlier tests, we came to the conclusion that the basics of geometry were assimilated more easily by the students if they were solved without using computer programs; in addition, a significant number of Peruvian students had had no access to computers before beginning university, which implied to greater efforts as they had to study while simultaneously learning to use a computer. The theory that it was more effective to teach geometry through traditional methods was made stronger by the observation of the progress of the students in this course; as it is an elective subject, engineering students also studied it along with our architecture students. We found that the students who had studied basic geometry in their first year were able to do the exercises more quickly and with greater skill than the engineering students who had not received this training, in spite of the fact that most of the latter were in the final years of their degrees. Thus, knowledge of basic concepts of geometry were found to be necessary before attempting to represent ideas with the drawing programs, as these should be considered merely suitable tools to improve the efficiency of students and qualified professionals (Fig. 6).

Fig. 6 Students working on a reproduction of the floor-plan of Fansworth House on the AutoCAD Basics Course

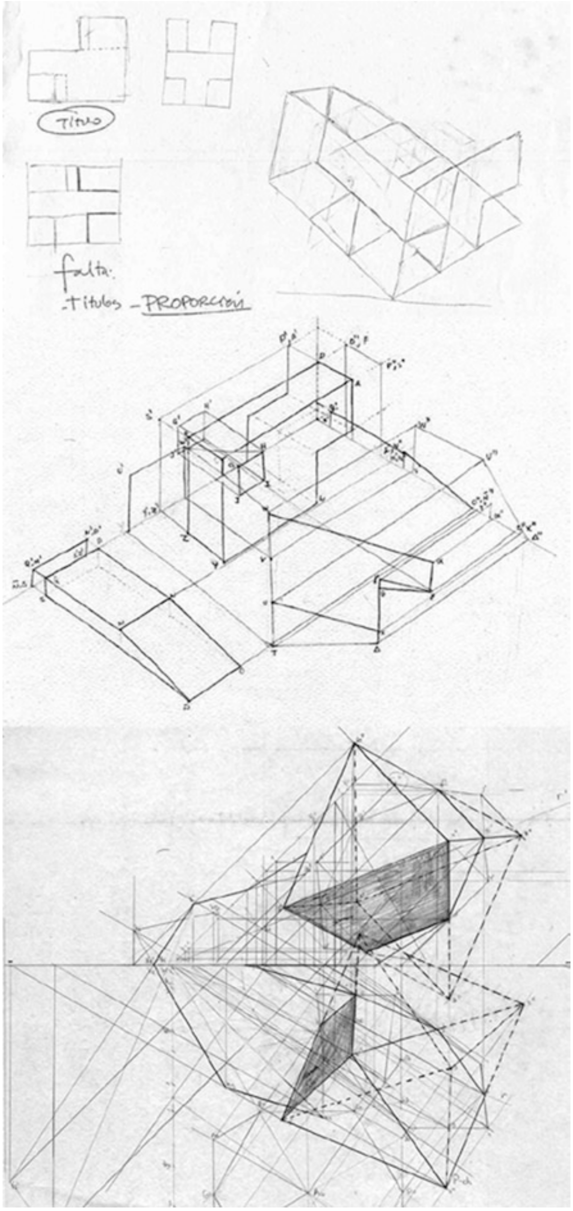

Fig. 7 Evolution of the spatial perception of a UDEP student

5 Final Comments

The study of geometry offers the students a great opportunity to improve their future and influence society. The wiser a society, the greater its potential for development. The skills which are stimulated with the study of this discipline (reasoning, abstraction, order, rigor …) are directly applicable to professional architecture and to life in general, even more if possible in our region.

It is impossible to imagine geometry as the teaching of a series of routine procedures without critical thought. The teacher must be the medium through which the student acquires knowledge, reconstructs and becomes capable of using it. Therefore, teaching must be based on different tools and methodologies which will allow the educational process to be guided in order to achieve the effective learning of the students.

After only eighteen months' application of this system of levels in the teaching of geometry, more time is needed to obtain trustworthy results on the appropriateness of this method, but so far what we have observed is very promising and the level of geometry reached by the students at the end of the first year of their degree is very high; it is comparable to that of European schools and much higher than that of other Peruvian universities (Fig. 7).

Notes

1. The Van Hiele model was developed in the Netherlands by the husband-and-wife team of professors, Dina van Hiele-Geldof and Pierre van Hiele. It has two components: the first is the description of the different types of geometric reasoning of the students throughout their training; the second is a description of how a professor can organize the activity in his/her classes so that the students can reach a level of reasoning superior to that which they already have. Although the model is specifically designed for the teaching of mathematical geometry, its principles can be extrapolated to the teaching of descriptive and metric geometry.
2. His ideas on the development of the representation of space and the way in which geometric ideas are progressively organized have outlined research studies intended to develop a sense of space and the reasoning of students' ideas and have guided curricular trajectories beginning in the 1960s. The influence is so marked that, at present, in most countries geometry has to do with the study of objects in space, their relationships and their transformations, which eventually have been treated in mathematical terms, and with the axiomatic systems which have been constructed to represent them. This means that developing the sense of space and of reasoning are determining aspects of the didactic phenomena which interest those who study the didactics of geometry.

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From the Mind to the Paper. New Techniques Applied to Architectural Drawing

Marta Alonso Rodríguez, Noelia Galván Desvaux and Antonio Álvaro Tordesillas

Abstract Regardless of the technique employed, that using drawing as an instrument for thought—as an intermediary element between the idea and its concrete realisation—goes beyond the medium itself which has been used to achieve this goal. An issue that we have to face is that of the lack of knowledge or the deficient implementation in the teaching of these new programmes, alongside the scarcity of time and means to work in virtual drawing, understood not just as the end result—to showcase a finished product—but also as a the usage of the domain of these new resources.

Keywords Architectonic representation · Virtual · Drawing · BIM · Parametric design

1 Architectural Representation in Today's World

Drawing is putting a line around an idea.

Henri Matisse.

The process of implementation of computerised means in the University has been outlined as a double-edged sword since its inception, back in the decade of the 1990s.

Its attractive as a quick representation system in the development phases of the project seems to collide with its incorporation into the early ideation stages, when there still exists some mistrust of whether the use of a certain program influences the final result. Although computer drawing may initially seem more restrictive and

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determinant—something that up to some extent limits the potential expressivity of handcrafting—it is true that if the adequate software is used for each stage of the project, astonishing results may be achieved.

We understand, regardless of the technique employed, that using drawing as an instrument for thought—as an intermediary element between the idea and its concrete realisation—goes beyond the medium itself which has been used to achieve this goal. An issue that we have to face is that of the lack of knowledge or the deficient implementation in the teaching of these new programmes, alongside the scarcity of time and means to work in virtual drawing, understood not just as the end result—to showcase a finished product—but also as a the usage of the domain of these new resources.

Mastering these virtual means grants us freedom to project and to be able to present an idea that must not be considered as the opposite of a drawing by hand, but rather as another technique that, as a complement, can be highly useful for us. In fact, thanks to the virtual world, we have been able to conduct projects that were very distant to what was traditionally based on Euclidean concepts and which provided us with an architecture of a great spatial diversity and richness.

For the past few years, we have moved from using computers for mere 3D recreation—what may be seen as something similar to what previously was single-view hand drawing—to creating files that allow us to virtually develop and manage much more information in a faster way. This wide range of programmes encompasses those aimed at drawing, such as *Illustrator* or *Photoshop*, to those that are oriented to the development of the architecture, such as *Revit* or *3D Max*. Providing virtual platforms that favour and ease the drawing duties is stimulating and motivating for our students since this is a medium to which they are accustomed, especially nowadays when new technologies are ubiquitous.

The progress of the implementation of new technologies in education is facing challenges, due to the fact that several different elements are required for its proper functioning. Up to a certain extent, a style of teaching that takes advantages of these technologies will have to be supported by virtual classrooms, Wi-Fi networks, new teaching methodologies, a proper training for the teachers and the students or the availability of updated electronic devices. In many instances we find that all the components of this material base are not present in our classrooms. Nevertheless, we think that teaching about the possibilities for knowing and working provided by this ample set of drawing computer programmes allows us to begin to design concrete experiences—in the form of workshops—which guide us towards a teaching model useful for future architects.

The use of the computer as a medium for design proves to be crucial both for the development of the process and for the final characteristics of the project. Disregarding its use in the education of a student of architecture, who will utilise them in their career by necessity, may simply result in an improper preparation of the architect for their future professional performance.

2 Adaptation of the Software to Each Education Phase

From a simplified point of view, we may think that computers are useful to us as mere auxiliary means for work. But a computer and its correspondent software might become a true instrument for knowledge that will help both to strengthen the knowledge of the mind and to develop the different processes that compose it.

From the point of view of the Department of Graphic Expression of the University of Valladolid, we have been developing a style of architectural teaching through computers based on a double approach. On the one hand, our teaching is supported by computer programmes used as tools to explain some concepts, such as the spatial conception of a representation system. On the other hand, we teach a programme in itself, not as just the mere explanation of a series of commands, but rather as the practical application on real models that make the students research and ask questions that would not appear in a purely-theoretical class.

Thus, we find that the students from the first few years—who have a very uneven basis of knowledge and formation—have not had barely any interaction with computer drawing programmes. In these cases, teaching is focused more on showing these students the spatial and graphic capabilities offered by programmes such as *AutoCAD*, *Sketchup* or *Illustrator*, instead of making them learn how to use a programme in itself. Using previously-planned practical examples, we gradually introduce the students to the use of computers, as a complement to the traditional teaching techniques. For example, in the subject entitled Descriptive Geometry, they can through a virtual space how a tetrahedron is located in the space and then extrapolate that spatial information to the duality of a representation system. In this case, the usage of the computer is not aimed at learning how to represent something, but rather at trying to ease the understanding of concepts through a simple instrumentation, such as the use of the virtual environments offered by programmes like *Sketchup*.

To the contrary, the subject entitled Advanced Representation of the Architecture II, which is offered in the fourth and fifth year of the Degree, is taken by students who already have had a substantial contact with computer-assisted drawing, especially on *CAD*, which in turn facilitates the work of the teachers, making them able to focus on the more concrete aspects of architectural representation.

The new technologies give place to didactic strategies based on collaborative learning, generating open ideation processes, so that it is the students who can ask questions related to their own ideas.

The students of this subject may check in place and in real time the changes that take place in their virtual models, such as the exchange of materials, compositions, environments or the exposure to sunlight, which turn the computer into a true instrument for knowledge and grant the student the ability to think and develop the different creation and ideation processes of a project.

3 Adaptation of the Software for Each Phase of the Architectural Project

Each Project begins with a draft. Creating a sketch with paper and pencil seems to offer the architect a freedom that is hardly applicable to the use of a computer. The journey of an idea in the mind to the paper—the first phase of the architectural project—has undoubtedly been one of its weakest points in terms of technology.

CAD drawings were, in a certain way, the analogues of the drawing in paper that we had until very recently.

The great progress made in the field of computer-assisted design and digital production technologies have had an important impact on the design of building and the construction practices. They have created new opportunities by allowing for the production and construction of greatly-complex shapes that had been, until recently, very hard to achieve and very expensive to design. With this we go back to the thoroughly-studied paradigm of having the means employed conditioning the final result (Kolarevic 2003). Thanks to these new technical means, complex shapes and geometries can become a reality, and with them projects that were previously unimaginable (Fig. 1).

The arrival of graphic tablets has enrichened the transition from drawing by hand to the creation of sketches on the computer, resulting in a task that is much more

Fig. 1 Campo Baeza rereads Jørn Utzon

similar to the use of a pencil. The virtues of this new medium are self-evident, and among them we can find how easy it is to make changes and corrections or the superimposition of layers that allow for a great number of options (Amado and Fraga 2015) (Fig. 2).

The main advantage of this medium is its immediacy and speed, as well as the versatility that it offers when changing elements of the drawing in a quick and efficient way. As a practical result, we can clarify that the main difference between the virtual and manual approaches is not very evident in terms of a substantial improvement in the technique of the student, based on the fact that the student who draws well does so with their mind and not with their hand. As long as the student is knowledgeable about the medium that they are going to use and how to use it properly, we can assume that the student who draws well by hand will draw well on the computer; however, the latter will have the added value of the aforementioned versatility and agility of the medium. It is not our goal with this to claim that hand

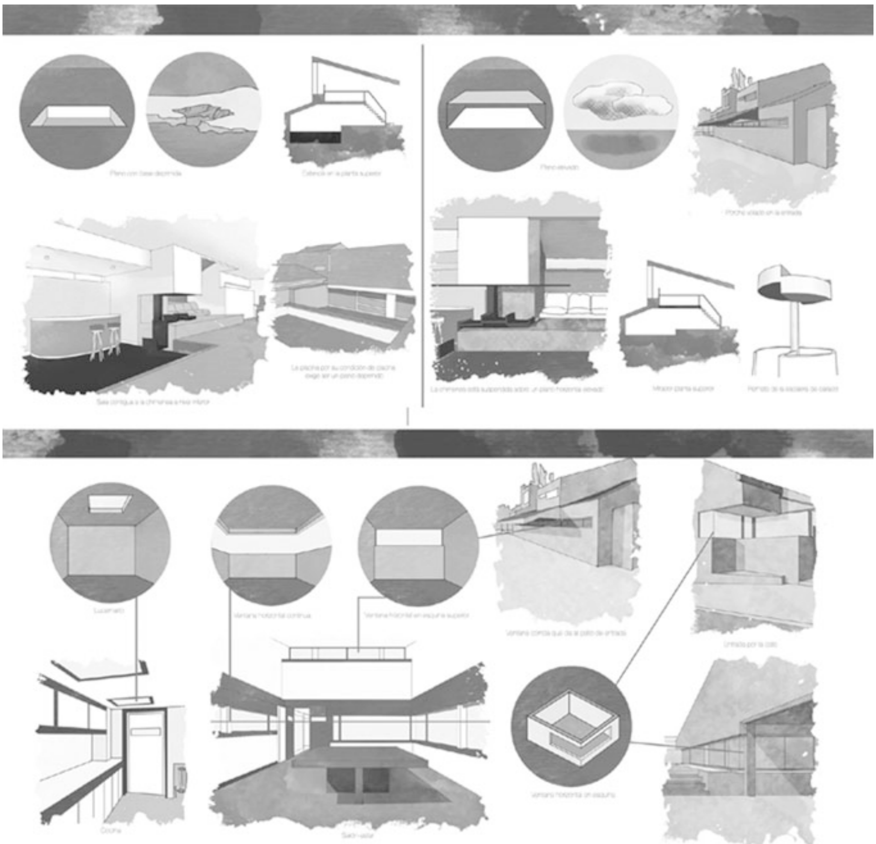

Fig. 2 Fragments of a print for shape analysis IV, created on a drawing table. Student Raúl Villafañez

drawing must be left aside or ignored by teachers, but rather just the opposite, since both approaches are complementary and from each of them we must choose the more evident advantages that it may offer.

Drawing in a Tablet is neither better nor worse than working on paper; each medium has its pros and cons.

The situation that we are currently facing offers a myriad of graphic opportunities that should not be ignored and with which students seem to be very comfortable, probably due to the fact that this is something to which they have been accustomed and, therefore, accept it in a much more natural way than many of us. The appearance of numerous drawing programmes applied to graphic tablets convert them in a working instrument for graphic expression whose possibilities need to continue being explored, both by teachers and by the professionals of the field.

3D printing—an element that has been somewhat relegated by our teaching due to lack of means—is our last topic of discussion.

Actually, the concept of extrapolating an idea to the real world and make it tangible is not a principle that belongs exclusively to the pencil, since many architects work with models, cut-outs, collages, and more, which in some way materialise that idea. In fact, in some of our subjects we encourage the use of models and physical mock-ups so that students get to know different methods and work processes from the very first courses of the Degree.

"The mock-up shares with the drawing that great expressive synthesis, which may well make it a precise instrument for knowledge of that set of ideas underlying the architectural shape". (Carazo and Galván 2014)

By representing a mock-up with a computer, using the three dimensions, its appearance is no longer limited to the use of certain materials, such as wood or paper; on the contrary, the capacity for expression that they may achieve without the limitations of that precise material—both in shape and in appearance—open new and unexplored territories for the student, who may have not seen them through other means.

A double objective is therefore achieved: on the one hand, we are able to represent virtual mock-ups that imitate their physical counterparts, and, on the other hand, we can establish virtual realities that imitate the building constructed around them, in a more or less analogous way to reality, according to what is trying to be reached (Fig. 3).

"The computer is like a pencil. It does not draw on its own. The drawing is an expression of a mental activity (…) It may be a finger on the sand, it may be a computer." (Souto de Moura 2007)

The render is just one of the many possible results of the design process. In fact, it need not limit itself to reflecting a future reality, as it may also be employed as a representation of a drawing of intent, more in line with hand drawing itself.

The inclusion of computers in the classroom and the use of virtual techniques has been met with numerous critiques, especially due to a deficiency in understanding and a limitation of the aforementioned applications to achieve as a result a unique finished element, such as the render. This is primarily due to the difficulty in

Fig. 3 Drawing of an apple created with the 3Ds max programme. This exercise is meant to be a starting point for students regarding the expressive and formal capabilities offered by the programme

changing the method for designing that are inherent to CAD techniques, which focus their work on the their own families of objects. In order to allow the future generation of architects to make the most of the advantages offered by the system, it is necessary to have a proper knowledge of it to be able to apply all the technical abilities we have learnt. These new methods for the representation of information have given birth to a transformation in the creation of ground plans and isolated sections, disregarding the building as a whole. The architect's approach—and in this case, that of the teacher and the student—must make a sharp turn in order to avoid limiting the use of computers to the creation of a render made after the design process is finished, but rather use the infographic instruments during this phase as another method for projecting (Fig. 4).

In regards to the last concept, we face the use of BIM applications. In contrast to simply graphically representing an object, the use of these programmes imitates the real process of construction. Instead of creating drawings with lines, we virtually construct the buildings modelling them with real building elements, such as walls, windows, slabs, covers, etc. This allows architects to design buildings in the same

Fig. 4 Render created in the 3D Studio drawing course. Student David Bravo Moreno

way in which they are built. With this integrated approximation of the model, BIM not only offer a substantial increase in productivity, but also a groundwork for better-coordinated designs and for a construction process based on the model.

BIM will transform both the product of architectural design and its own process. BIM is not a drawing tool, but rather a way of thinking—a conceptual position (Ambrose 2007). The method used to build the model must be considered as a design decision. Students have to understand not only the geometry of the model but also the implications of the shapes in the model that is being built (Cheng 2006). So far, the process of graphic representation has been fragmented in the drawing of the elements which, although related—ground plan, elevations, sections—and definitive of a whole, were destined to be represented in isolation, individually. BIM works in reverse: starting with an integrated whole, which is the 3D building, we can obtain the aforementioned virtual representations with the paradigms that we assign to each of them. Furthermore, with these new techniques the knowledge acquired through a project may not only be applied in another one, but also directly extrapolated, since the student can create and save architecturally-based teaching and in the means that we had so far for expressing and teaching the design. The teaching approach that has been employed for the development begins by providing the students with data from a real model, which allows them to extract information that will be useful for the development of the project. The exploration of the potential of these programmes through an applied approach is one of the key components of these new ways of teaching. It also offers us an unparalleled system to revise the architectural design, allowing us to make systematic changes in real time in all the views of the project, which in turn provides us with a critical analysis of both the method of representation and the architectural design. Taking all of this into account, it is more than obvious how this kind of tools has fully entered the ideation process through the use of the new technologies (Fig. 5).

Moreover, the new options that have arisen in the field of architecture with arrival of parametric systems enable us to design a process and not a concrete result, which allows us to explore more than one result, with certain design premises that had been previously established.

By achieving a design process and not a pre-established shape we can manipulate its variables and properties to transform the final result, which we can modify in real time and, therefore, compare options, in order to obtain a more efficient result adapted to our idea more quickly.

Although at a first glance this may seem restrictive and conditioning in terms of the expressivity that the final drawing shows, once again the graphic ability of the student, as well as the interoperability with other programmes aimed at graphic design—such as *Photoshop* or similar applications—make it so the project does not lose any graphic capacity, but rather improve in quality and constructive definition.

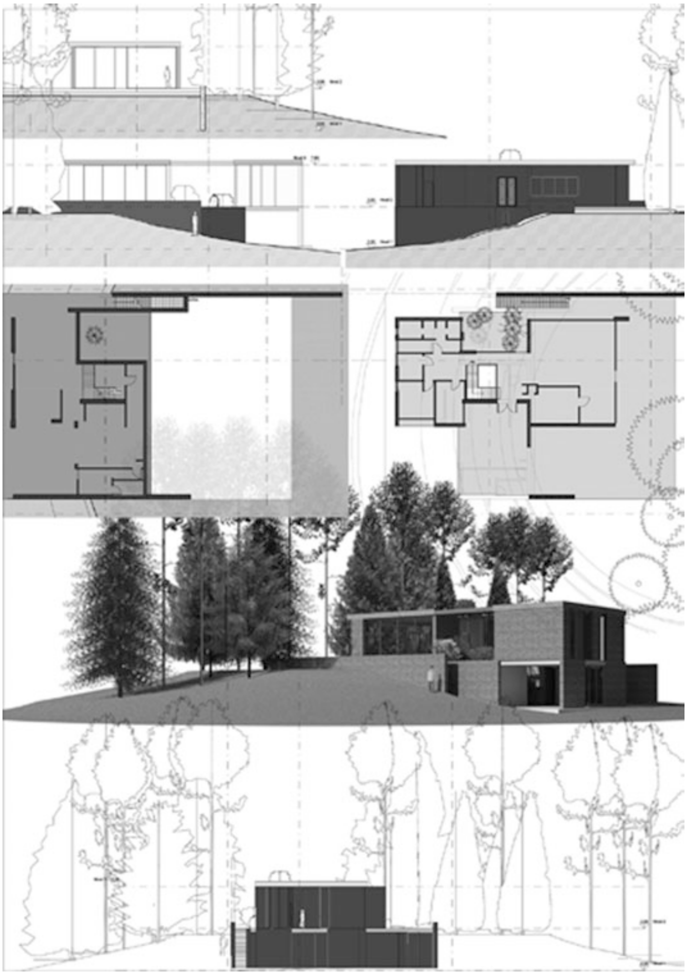

Fig. 5 Print for advanced representation of architecture II, created with REVIT. Students Héctor Jimenez Merino and Jesús Luna Buendía

4 Conclusions

It is a known fact that the advances made in the field of architectural representation have brought forth a change in the ways we understand the architectural space. Works such as the Hall for the World Fair in Zaragoza by Zaha Hadid or the Guggenheim in Bilbao by Gehry would have been impossible to create without the aid of modelling programmes that supported the capacity for expression required to conduct them—besides, of course, the advances in construction needed to develop them.

By transmitting to the students the Basic knowledge required to be able to work with any graphic mean, be it by hand or with the support of digital platforms, we are offering them the ability to generate geometric shapes outside the scope of the set-square.

They do not just learn a method of expression and representation: they generate new spatial conceptions through the virtual realities created by computers.

With the arrival of BIM and parametric systems, architectural representation is no longer limited to a lineal development. It now allows the student to quickly and continually update and revise their ideas. Parametric representation is based on the description of its own modelling process, which offers a radically-different option to face the problem of representation and, by extension, of the design itself. "Parametric representation works on the design process by modelling and not on its final product. This makes it possible to rewrite the history of a representation at any given time, altering parts of it and observing its consequences" (Coloma 2012). Design ceases to be an hermetic object and, even if the first process of parameter recording may certainly be cumbersome, the possibilities offered by not working on a closed system finally manages to win the students over despite that previous phase. In conclusion, saving so much time thanks to the speed with which the changes in the project are made allow them to be able to explore several variants of it without negatively affecting the representation.

Furthermore, the current situation has carried a change that students must face when they enter the labour market, since, currently, architects are beginning to rethink their place. Searching for new professional outlets related in part to architecture—such as the fields of design, graphic design, architecture workshops, heritage circulation techniques, cinematographic sceneries or even the creation of environments for video games—further support the idea of educating future architects in a multidisciplinary world. Exposing the students to a wide range of possibilities, through the teaching of several different drawing programmes, improves their specialisation, allowing them to be much more open to other alternatives in the future.

What we should try to achieve while teaching architects is the learning of a process, not that of a representation system or a programme in itself and its commands, which allows them to face an architectural project and conduct it with the adequate knowledge and methodologies.

Just like the pen has never unseated the pencil, or the watercolor has not replaced the drawing charcoal, each graphic medium—be it manual or virtual—offers to the student the option to find the means of expression that suit them the most, and by teaching them we are making it easier for each of them to discover that which is best for their goals, from expressing an idea to explaining a concept.

Despite the attempts at promoting and introducing these new tools, the knowledge acquired throughout the studies of architecture prove insufficient for the current demand of the market, and therefore it is necessary to establish courses and post-graduate programmes to be able to face more resolutely the range of proposals that architects will encounter as they develop their trade.

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Descriptive Geometry and its possible contribution to teaching: restitution simple techniques and low cost. In addition to teaching publications, has articles and conference proceedings dealing with the issue in Spain, Portugal and Italy, where he also teaches; as well as a national R&D and international.

Values and Strategies to Adapt Training in Architectural Graphic Expression Around Digital Technologies and Social Networks

Francisco Martín San Cristóbal

Abstract The paper contextualizes the disruptive moment that Architectural Graphic Expression (EGA) and its teaching are living, compared with other disciplines and historical moments in which there were social changes due to technical innovations. Several authors, whose contributions are referenced in disruptive moments, are quoted, regardless of their nature (digital or not). Changes must be dealt with more disruptions, pushed and controlled by EGA and by teachers that will internalize the new paradigms of communication. Teachers will learn this new way of communication because we're "digital immigrants" and we need to understand the "digital natives" to bring them the EGA values.

Keywords Disruption · Digital · Network

… Horse carriages are no longer used but horses have not become extinct …

With this phrase, Professor Javier Diaz—Gimenez, concluded a master class in May 2015 at IESE in Madrid, where he is professor of economics.

Traditional ways of doing, of social organization, the different kind of jobs… all of these disappear and are replaced by others, due simply to innovation and the new uses that are made of them.

Deirdre McCloskey has explained how innovation becomes virtuosity and how the industrial revolutions can mean, under a creative prism, a moment of freedom.

In the first decade of the twentieth century, manufacturers of carriages and horse breeders saw their livelihood disappear in a few years and new players entered into the market, for instance, the combustion engine, the assembly line and a new social organization. All those people, who worked well with their horses and carriages, with quality and in a thorough manner, stopped being useful to society and had to reinvent themselves or die.

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Similarly with dinosaurs: after a laborious and careful evolution of thousands of years, Mother Nature turned them into the dominant species… But something happened that, despite its perfection and value… stopped them from being dominant. Some of them adapted but others disappeared.

In each case, disruptions were the reasons for these revolutions. Within an orderly and predictable evolution of things or events, all of a sudden, something that is not predictable, but rather, strange and illogical may happen.

This is the way writers such as Tony Seba understand disruptions: When he talks about disruptions taking place in the field of energy thanks to digital technology. Lokewise, other authors such as Charles Morris when he explains the revolution in cars, not only because they are electrical, but because they are so closely connected to the digital area that it is difficult to differentiate them from airplanes.

This reasoning spearheading the field of architectural graphic expression today poses the same analogy: If we continue thinking about drawing or teaching using our old criteria, our old reasoning, old techniques, old values, old processes… we will certainly continue achieving high quality graphic expression, but it will not be adapted to our present time.

We have to examine whether, in this historic moment in the development of internet, devices, social networks, etc. we are confronting a disruption which is telling us that architectural graphic expression must either adapt or die.

1 Let Us Attempt to Find Out Whether We Are Capable of Sensing a Disruption

As mentioned above, profound changes have been initiated in all professional sectors, due to information technologies and communication, big data, social networking, smart cities, the internet of things… In a broad sense, architecture can be understood as a social organization that today uses new languages, with people living architectural spaces differently, with a "device" in their hands and connected to the Internet and social networks.

Everyday we use our sketchbooks less and less, we read fewer paper books and yet, we are increasingly connected to the Internet in real time.

In this context, those who previously placed their advertisements on television, newspapers or radio, can no longer send indoctrinating messages, politicians can no longer manage their own speeches… It is now online conversation which determines the influence of the message, and makes it grow or disappear.

Similarly, those who made conventional music used to sell their products through the traditional labels on physical media whereas now, this model has changed completely.

The same now applies to films, with even premieres being provided online, thus drastically changing the business model of the cinema industry.

People no longer sell or buy in stores, they now buy online and they only go to the store to try on the merchandise or simply to collect it. Here too, the model of shopping has changed.

This is the social and technological context in which our graphic expression students arrive to our classrooms. Perhaps they do not know as much about the Internet as those pf us who have studied it. Being digital natives, our students are not very conscious of technical processes. For them, technologies are their native language and their natural environment… But those of us who are digital immigrants, we run the risk of understanding the tool as an means.

While digital natives use the information and communications technology automatically, unconsciously, fluidly and naturally, without delving into the structures that support the language but using it to solve their problems, people who are digital immigrants question these technologies non-stop and, surely, we must sometimes lose focus trying to explain/teach "the same old stuff" but with these new technologies… Perhaps we should not only teach "the same old stuff": teaching perspective in "photoshop" or teaching drawing sections on "AutoCAD" and editing them on an online blog would mean not understanding the present.

Hence, is the teaching in architectural graphic expression sustainable? Is this disruption in social relationships affecting our area of knowledge?

At this point, in order to prevent a radicalization of the discourse, it is true that humans develop skills that transcend technology such as logical thinking and communications or managing frustrations to make it another step in the learning process, curiosity, speaking, writing… Community Management and Gamification professor Perez-Chirinos speaks in this sense in his article "Digital Natives and Functional Illiterates". This exception is thus established in order to narrow the work field to which we refer in this text.

To return to the issue of whether technology affects our area of knowledge:

I can remember the first international architectural graphic expression congress I attended in Coruña in 2002 where the speakers talked about how to use CAD, and their discussion on hand drawing and computer drawing.

Today we seem to have gone beyond this debate, at least in technical drawing and geometry. We are also gradually going beyond this discussion in the field of architectural drawing ideation.

Now, however, the change is no longer in the tool, but in the way of relating to other people, in the values, in the flow of information… Do today's students understand spatial relationships just as students did before? If we think about how difficult it is to communicate with a person who is in Australia, then I will understand that their concepts of space and time are very different from mine.

Digital natives have all knowledge available in a "widescreen" or "panoramic" way, that is, through many devices, anywhere, anywhen. Knowledge is accessible at a mere "click".

Digital immigrants, who have been educated by other means (in comparison to what is today accessible, I would say that we have been brought up with limited means), have a way of thinking contrary to the "panoramic". We have a "deep" mindset. By this I mean that we never had all the knowledge and information in an immediate way, and this circumstance forced us to prioritize, to sort, to place certain things before others… and in this manner creating an intellectually rich and powerful mindset, which is, perhaps, unnecessary today.

This is why I suspect we are facing a time of disruption where information does not hinge on the classroom, in which the "influencers" are more highly respected by the students than is the teacher (simply because he uses the same communications channel…) Now, it is not a question of Architectural Graphic Expression having to step into the Internet in the way that it took the step into CAD in the past; now we have to re-think how to become connected to the current values.

Today, an "influencer" or "blogger" has more impact than a teacher or an orderly course regulated in units, with content and evaluations. In this respect, we have to quote the online article published in the "ojulearning.es" site in May 2012, written by e-learning specialist teacher Daniel Rodriguez Romero who, quoting professor Marcelo Carlos from Sevilla, specialized in customizable learning networks, explained how very complex contents and sophisticated processes can be learned simply through the student's initiative, by taking the blogs and forums as a starting point and then by filling only the gaps that the students themselves are interested in filling. This shortens the learning curve exponentially and makes the students manage their own training, interested in their own subjects… or, what is the same: Students program their knowledge… And Rodriguez also recognizes that, in the background, this is what we are all doing today even though we are not the learners of a regulated education.

2 A Strategy to Approach the Disruptive Present Time

Perhaps, although we are living it in present time, we lack the perspective to analyze it adequately and we can therefore only provide insights. In any case, these insights are based on the following three points: Training has three legs, which are knowledge, skills and values.

In relation to knowledge, EGA can produce content, but it must be relevant to the surfer. If the surfer thinks the contents are relevant, then he will decide to learn them, but he will learn them in the new neuronal structure, in continuity with the social networks. Consequently, any content EGA may develop must be turned into a correct format for online sharing through tutorials, videos, micro stories… and conveniently positioned to occupy a relevant place in the search engines and capable of being shared.

On skills, we should think whether drawing today should happen on more adequate technical supports such as tablets, Smartphone formats, or collaborative software for real-time exchange.

Values… this is where I believe EGA must remain strongest: to provide students with emotional resources which, along with its cultural resources and skills may contribute to the students' ability to mobilize such resources and provide solutions for society… but their own society, the one that the student himself will find.

Finally I would like to refer to the article "5 Ways Millennial Planners Are Going To Change The Meetings Industry' published online. In this article, David McMillim explains five ways in which the so-called "millennials" are intended to transform the ways in meetings and exhibitions.

A "millennial" is a step beyond a digital native. A millennial is a hyperconnected person, who uses different devices and designs his own experiences, in such a way that he will never accept a preset package. They seek bespoke things, more still: they seek to do whatever to their own measure because they are increasingly demanding all products online.

Therefore, a millenial is highly demanding, and will be so with Academia.

In the above quoted article, an explanation can be found on how millenials would like presentations by bosses or trainers to be (more structured, shorter, less regulated), how they would like the meetings to be carried out (more effi whenever and wherever), how they would like the environment to be (more free, anywhere and not necessarily every day), how they would like "face to face" relationship to take place (they not only like the online world, but also the off-line world), etc.

This article is based on surveys carried out with senior students and provides further insight into how teachers can approach the current training and communications reality with the new generations, in this disruptive context.

3 In Conclusion

We are at a disruptive moment, we have gone from an evolution where we have exchanged the stylus for the CAD, with similar processes and results. But now, EGA is going from the board or PC to the cloud and this change is most significant and unpredictable. In the same way that disciplines such as marketing have had to invent new terms such as "viralizing" or "360 strategy", in politics you now have to use the term "trending topic". In EGA, we will have to start using similar words… Perhaps even use a new language.

We can continue believing that our old drawings are valuable, that we have made brilliant renderings and that they have unquestionable intellectual discourse that goves them support, but I fear that we may be, without realizing it, like those horse caretakers who kept them healthy and clean through great effort and great affection, and suddenly found themselves having to put down those horses because they were no longer needed.

"When Batman and Game of Thrones' are the main characters in scientific studies. Popular culture introduced in the pappers" is an article written by Cristina Sanchez and published in "Confidential" in June 2015. This article explains how science fiction can also be studied to meet peer review standards and manage to access indexation in prestigeous journals, but it seems clear that there is a disconnection with reality… at least with the reality to which we are referring here.

How to confront these changes? EGA and its teachers must spearpoint more intentional disruptions. Teachers should internalize the new communication paradigms. We must make the effort to internalize what we have to learn because we are digital immigrants. We have to understand the digital natives in order to provide them with the EGA values…

Within the scope of training, everyone will have their own values.

In any case, in relation to the necessary adaptation required to overcome extinction, I would like to cite three authors whose contributions will always be valuable in times of disruption (whether digital or not).

Peter Palchinsky, the Russian engineer who challenged the 'pathological resistance' of the Soviet system to any kind of experimentation, and ended up being liquidated by Stalin, as quoted by Tim Harford on "Adapt. Why Success always Starts with Failure" and listing the required steps:

– Find new ideas and dare to experiment with things you have never done before.
– When you try something new, do it on a scale that allows you to survive if you should fail.
– Ask to be criticized to learn from your mistakes.

Tim Harford himself is the second of the authors. In the title of his above mentioned work, the need to educate in managing frustration during any adaptation process is clearly expressed.

And, of course, applying Samuel Beckett's wellknown quote:

Ever tried. Ever failed.

No matter.

Try again. Fail again.

Fail better.

to everyone involved in teaching and learning processes.

Finally, we must talk about the "panoramic" mindset of digital natives and the "hyper-demanding and personalized" mindset of millennials and we nust compare these ways of thinking with the "deep" mindset of digital immigrants, perhaps assuming that the "panoramic/millenial" (all devices, everywhere, everywhen and my measure) is the framework has come to stay. Despite our "deep", thinking we have to assume that it may not be applicable to today's society. And so, once assumed, we need to find a way to have something in common, from one generation to the next, we have to do it together, we need to assess this new way of thinking positively and attempt to understand it in order to continue down the road together with our students… So there can be an exchange of values between the two generations at the moment we find the common place.

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The Traveling Snake. The Sculpture of the Eco Experimental Museum in Mexico City Visits Barcelona

Héctor Mendoza Ramírez

Abstract As a tribute and in relation to the centenary of the birth of artist Mathias Goeritz (Danzig 1915—Mexico, 1990), the sculpture "Snake" which Goeritz made for his Experimental Museum "*el Eco*" in Mexico City in 1953, was used as the starting point of the course work. (Architectural Representation III ETSA Barcelona from 2014–2015). The goal of the course was to motivate students in their creative ability and imagination in order to achieve, not only instrumental solvency in different techniques of Architectural Representation, but also the initiation of a visual culture that will be enriched during their professional life.

Keywords Photomontage · Sculpture and public space · Student work

Mathias Goeritz (Danzig, 1915—Mexico, 1990) has been a leading figure in Mexico, not only for their artistic contribution but for his professional relationship with architecture and urban sculpture, highlighting among others, his co-authorship in Satellite City Towers in Mexico City made together with Luis Barragan.

Goeritz moved to Mexico in 1949 invited as a guest professor of the first School of Architecture in Guadalajara.[1] In Mexico, the German artist took advantage of the benefits of an era with fertile ground for artistic and architectural creation. Goeritz, in addition to visual art and sculpture, was able to make contributions that influenced the relationship between art and architecture.

In 1953, he was commissioned to design the vibrant project of the Eco Experimental Museum in Mexico City. This space was his material manifesto of what he called *Emotional Architecture*. The museum shows sequence of spatial

[1]Mathias Goeritz taught a course called Visual Education; it consisted in graphic and plastic explorations in order to motivate the creative capacity of students. The course, according to Ignacio Diaz Morales, the director of the school in Guadalajara, was based on Joseph Albers ideas of "The Language of Vision".

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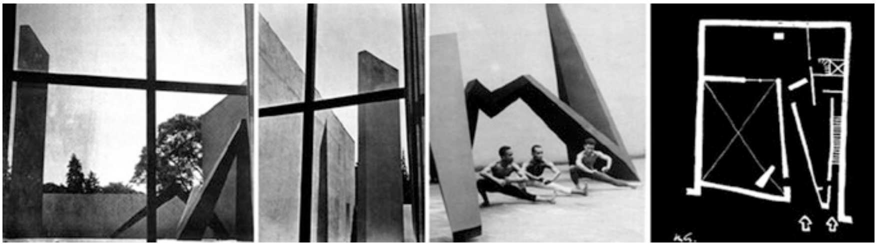

Fig. 1 The museum courtyard and its occupant: *the Snake* and the museum plan drawn by Mathias Goeritz. Material extracted from Ph.D thesis Partida Muñoz (2005): "Museo Experimental Eco" en *Hotel Camino Real. Cruce de Trayectorias de Artistas y Arquitectos en la Ciudad de México*. Universidad Politécnica de Cataluña, Barcelona

contrasts, with corridors that get narrower while you walk as a kind of prelude to a larger room; sudden changes of height and lighting that enrich the journey that culminates with a clear view into the sculptural patio. This patio has an uneven geometry, and it was complemented by the dynamic presence of the *snake*, the sculpture Goeritz expressly made for this space, imagining it as a background to events, artistic performances, or as the inhabitant of this contemplative space (Fig. 1).

The snake sculpture was removed when the museum closed a year after the opening. And in 2005, when the museum reopened, the snake did not return. This fact made us think that the singular piece became an itinerant object, a traveling sculpture.

During 2015, the centenary of the birth of the artist is commemorated, and a series of tributes have been held around his life and work, such as the exhibition named "The Return of the Snake" hosted by the Reina Sofia Museum in Madrid and later presented in the *Antiguo Palacio de Iturbide* in Mexico City.[2]

Regarding the centenary of the birth of the artist and understood as a tribute, it was proposed to work around the sculpture that Goeritz made for the museum, using "The traveling snake" as the title of one of the exercises developed during the 2014–2015 Architectural Representation III course at the ETSAB (Barcelona School of Architecture). The exercise took as starting point the fact that the snake was not returned to the courtyard of the museum. This made the group think about the possibility of the sculpture as part of an eternal and itinerant exhibition. For our course, the traveling exhibition took place in Barcelona.

Since the figure and work of Mathias Goeritz have not been widespread outside the specialized media in Mexico, at the beginning of the year, students conducted a short research on his work. Students focused mainly on Eco Experimental Museum

[2]Full name of the exhibition is: The Return of the Snake. Mathias Goeritz and the Invention of Emotional Architecture. Curator: Francisco Reyes Palma.

and the rich angular geometry of the sculpture that inhabited that space. This geometry offered the occasion to test, not only the visualization of materiality or different ways of lighting an object, but the chance to explore the capacity of transforming or reorganizing space around the sculpture.

Building on the course objectives, including digital image processing, digital modeling, photography and montage, students individually developed resources for designing an installation of this sculpture and its corresponding impact on different recognizable areas of Barcelona. The course was reinforced by a series of lectures and parallel exercises, which helped focusing the class beyond the merely instrumental issues, like a paper on photography of architecture and the figure of Francesc Catalaroca3.[3] There was also a lecture about the Architectural Representation different young offices made in order to show their interventions the Eco Experimental Museum.

In parallel, each student chose the work of an architectural photographer, in order to learn from their particular views and characteristic points. It was a main interest of the course to guide students on the importance of communicating a spatial idea with a single still image. The actual observation of the work of photographers, suggested students to recognize recurrent themes on image composition, like framing strategies, layout and proximity between planes, proportion, geometry and spatial relationships of the elements within the image. Along the course, it was stated that the elements in an architectural image cannot be other than intentional, never casual. Same elements and strategies that, as will be seen later, would be required to be implemented in each student's presentation.

The exercise continued with the proposed selection of a recognizable public space in Barcelona. A singular and representative place in where the sculpture of Mathias Goeritz could integrate. Each student imagined a scenario taking as precedent the opportunities that this sculpture offered in the courtyard of experimental Eco Museum, whether as a backdrop for various events, or challenging the configuration of the space and the perception of it.

At the same time, the student had to undertake a study of materiality applied to Goeritz sculpture. The student was motivated to alter the original finish of the snake, black steel, in order to strengthen the integration of this sculpture in the selected public space. This exercise motivated the imagination of students, so it turned into the ideal excuse to introduce an instrumental class, and learn around the creation of materials for the visualization of a digital model, trying to go beyond the use of the original palette available in different rendering softwares. Each student had to come out with at least three variants of materiality applied to the sculpture and its justification in the incidence of such materiality in the proposed public spaces. Such variants of materiality should include a component of creativity that forced the development of new non-standard materials.

[3]This Lecture was given by the guest Lecturer Judit Taberna. Professor of ETSAB at the Visual Communication Department.

The special geometry of Goeritz's sculpture offers the chance to elaborate on simple but very relevant concepts, like the differentiation between the light and the shadow faces of an object, between the own shadows and projected shadows, depth, opacity, reflection, etc. It is interesting to note that the ambition of exercise led students to think about the tectonic aspects of the sculpture with new materiality. Sculpture presents faces with different inclinations, and that fact forced students to orientate materials on each side, in the way that corners had a constructive logic and not just descriptive or pictorial perception.

As exemplification of the above mentioned, in Fig. 2 the student imagined placing the sculpture of Goeritz in front of Santa Catarina market, a project by Enric Miralles and Benedetta Tagliabue. This proposal led student towards a deep learning which began studying the surface of the market and its materiality, continuing with the generation of a new rendering material for the object, and culminating with the laborious placement of such material in the different faces of the sculpture. All this, bearing in mind that the proposal should visually connect the work of two great masters.

Moreover, there were students who proposed to alter, not only the surface of the sculpture, but also the geometry of the snake itself. Figure 3 shows a photomontage in the interior of Barcelona Central Station, in which sculpture's geometry corresponds to the continuation of the same rails coming from the train tracks. The student took into account the lecture about Francesc Catalaroca, and tried to integrate the sculpture in a similar atmosphere to the one captured by the Catalan photographer.

During the course, students are explained that the technic of photomontage allows working with both, the foreground-figure and with the figure-background. So in this exercise the snake is understood as the figure and Barcelona is the background. In that sense, students were motivated to manipulate, and transform the background photograph, in order to achieve the intended conceptual and graphic integration; their idea was expressed clearly.

Fig. 2 The sculpture surface imitates the texture covering the roof of such emblematic building. Miquel Benedito. *The traveling snake. Santa Catarina Market*. RAIII Architectural Representation III. 2014–2015. Professor Hector Mendoza

Fig. 3 Saray Bosch. *The Traveling snake. Estación de Francia and Francesc Catalaroca*. RAIII Architectural Representation III 2014–2015. Professor Hector Mendoza

Fig. 4 (*left*) Gloria Martinez. *The Traveling Snake. La Barceloneta*. (*right*) Mario Cuevas. *The Traveling Snake. Parc Güell.* RAIII Architectural Representation III 2014–2015. Professor Hector Mendoza

The image processing work in our course focused on searching for graphic nuances and hues. We used image processing software in order to potent the manipulation of all different layers in order to test strategies that reinforce the student's graphic discourse; highlighting the importance of the idea and fading graphic presence to the rest of less relevant elements on the image.

In this sense, each student worked their own graphic scenario and conceptually independent from the rest of the group. In Fig. 4 it is possible to observe two totally opposed strategies. In the first, the student sought to integrate the snake in a contemplative atmosphere on the beaches of Barcelona, and it was necessary to eliminate street furniture leaving nothing else but a pure landscape and natural atmosphere. Instead, the second strategy presents the snake visiting Gaudi's *Parc Güell*. In the original background photo, many of the representative elements of the park were under repair, so the student had to work in adding those taking them from different photographs. Likewise, some work had to be done to the photograph

Fig. 5 Mar Amengual. *The Traveling Snake. El Mercat del Born*. RAIII Architectural Representation III 2014–2015. Professor Hector Mendoza

showing Barcelona skyline; some change of scale was altered to the relevant urban icons in order to get more evident. In addition to those changes, some additional foreground elements helped make the sculpture integrated within different levels of the image.

Figure 5 shows how the student took the photograph of a recently renovated public space in front of *el Born* market. This student work, unlike the previous ones, used as a background image an architectonic reference, in which the emphasis was put in highlighting the relationship between the different textures and materials that define the space in order to relate existing materiality with the snake. The materiality of the sculpture arose from the idea of using "rope" as a snake analogy, exploring the generation of the volume by wrapping the linear element around the sculpture. Therefore, in order to establish a clear dialogue between the different textures and materials with the snake, a subtle and effective background treatment was made. That background image treatment included a slight correction of the perspective, the disappearance of street furniture elements and the blurring of the people featured in the open space. By blurring the elements in motion, the static elements, the snake and the market facade, obtained more importance. Although this communication does not support color images, it is worth noting the work done on the color manipulation of all different image planes in order to place the sculpture into context.

As a complement to the exercise of photomontage, it was requested the submission of a large format layout drawing in which the student would summarize the steps used during their own process. It should include the early study on the work of the architectural photographer, the material idea applied to the sculpture, the generating ideas or intentions sought in the image and finally the final image or photomontage. Although it was introduced, as an instrumental part of the course, the use of appropriate software for large format sheet layout, the aim was to deepen student on issues of organizing graphic information according to their own discourse.

In the work shown in Fig. 6, the student succeeded, not only to present synthetically the exercise, but also to make evident the link of the photomontage to some of the principles observed in the photographs of Erieta Attali. About Attali's

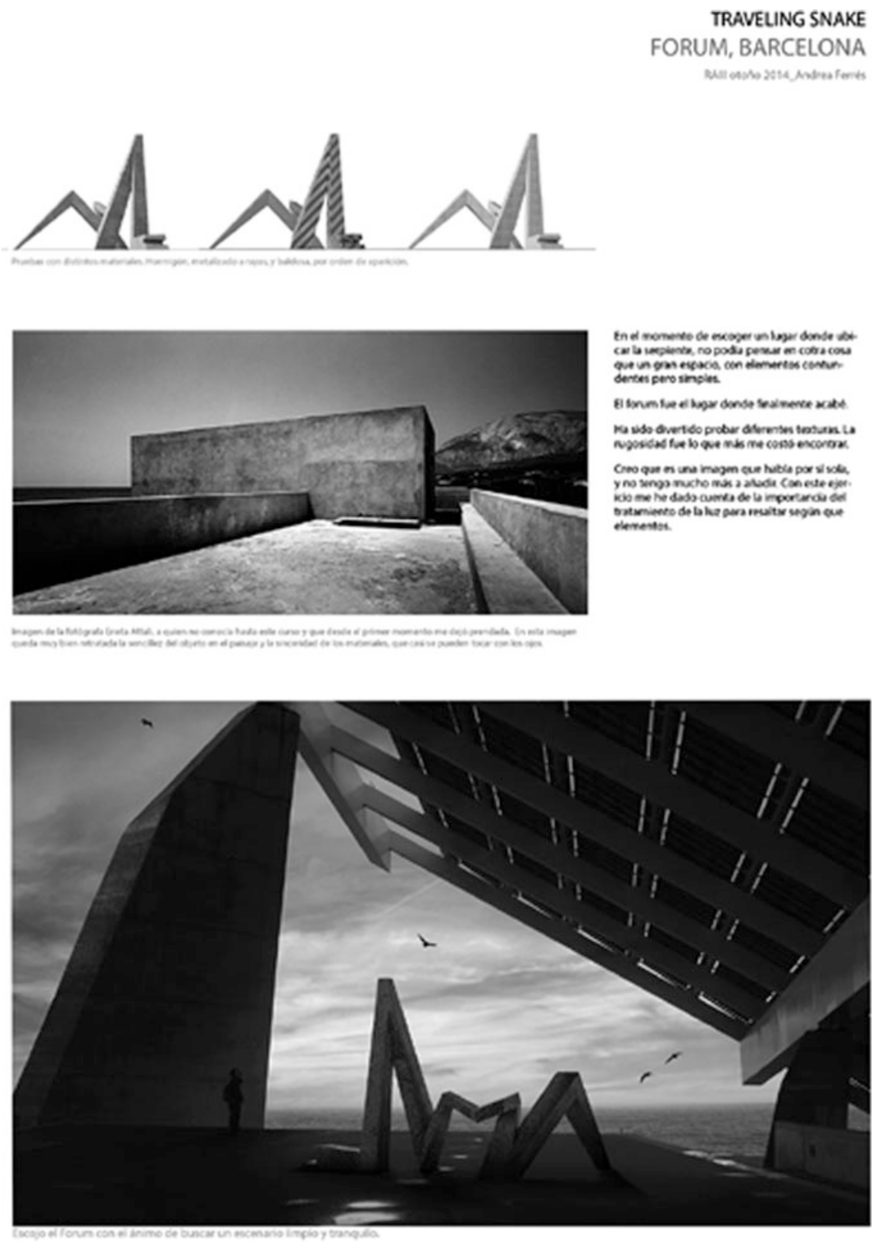

Fig. 6 Andrea Ferres. *The Traveling Snake. Pérgola Forum 2004*. RAIII Architectural Representation III 2014–2015. Professor Hector Mendoza

photographs, the student highlighted the clarity with which the geometry and texture of the constructive elements, as opposed to natural and open environment, is perceived. There is an incidence in the play of contrasts between light and shadow, materiality and nature in student's image.

Finally, the students had to adapt their photomontage to a postcard size format. The original idea is to gather a collection of images that assembled in this format would be sent to the museum where the work of Goeritz is exhibited and become part of the series of tributes around the artist. The contact with the Direction of the Eco Experimental Museum in Mexico City has been made. The response has been positive.

In Fig. 7 the snake of the Eco Museum is presented in one of the most iconic spaces of modern architecture, not only in Barcelona but, on the international scene.

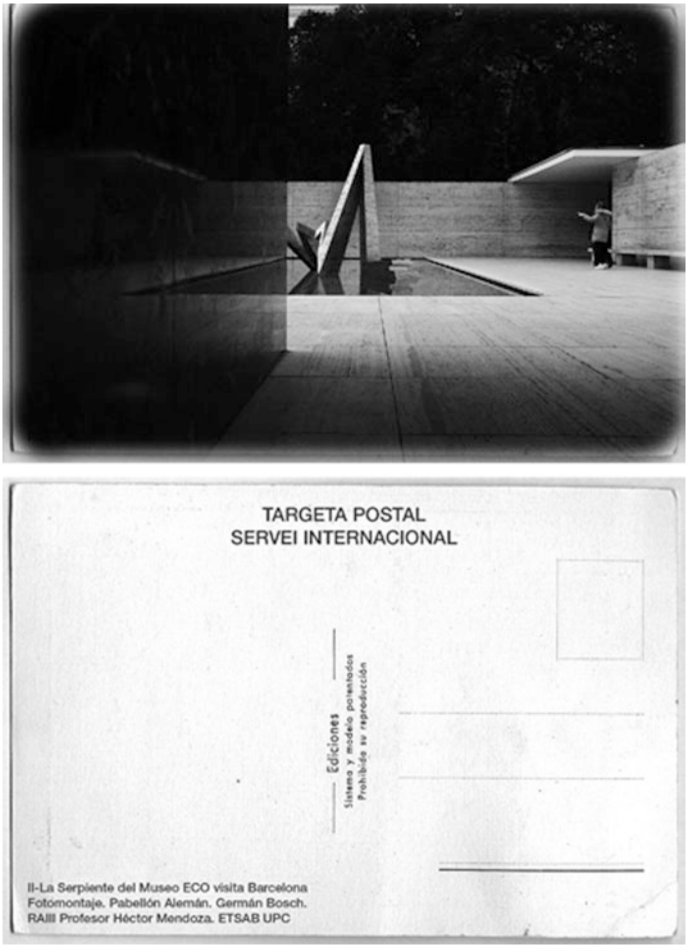

Fig. 7 German Bosch. *The Traveling Snake. Barcelona Pavilion.* RAIII Architectural Representation III 2014–2015. Professor Hector Mendoza

In this picture there is the possibility of comparing the scale between the Barcelona Pavilion and Experimental Museum, and it is possible to observe the dynamism that the presence of the snake adds to outside spaces. The selected point of view is framed by architectural elements and is successful taking into account that the snake, in its original place, was used to be seen from the inside of the museum having the sculptural window frame of main interior hall. In this image, the snake adopts the same materiality as the surrounding walls, making a direct connection with the monument. In a diagrammatic section the student suggests that the presence of this new sculpture on the outside and placed on top of the water is related to the anthropomorphic sculpture that inhabits the other courtyard located inside the pavilion. Finally, the photomontage was prepared to be presented at a post card size, suggesting the type of material that is offered to institutions that disseminate the work of Mathias Goeritz.

This paper presents synthetically the research on Mathias Goeritz, and with more detail some of the work processes implemented by students. This presentation only includes some outstanding exercises chosen from the collection that holds more than 100 high quality images, ready to be reduced accordingly to the title "Traveling Snake". This communication highlights the creative and imaginative capacity that each architecture student has, and motivated in this sense, is capable of developing instrumental and technical competence in the various techniques of Architectural Representation.

It should be noted that the role of tutor, although it was to provide the basis of proper technical knowledge of the different tools, had an impact primarily on promoting the visual culture that strengthens the proper communication of an idea or architectural intent, a visual culture that should continue to be enriched along their education and professional life through observation, curiosity and creativity.

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The Creative Experience. Reflections on a New Model of Education in the Field of Architectural Graphic Creation

Javier F. Raposo Grau, María Asunción Salgado de la Rosa and Belén Butragueño Díaz-Guerra

Abstract Completed the first five years of implementation of the Bologna Plan in the teaching of architecture, it is difficult to make a serene balance on its suitability in such a rapidly alterative context, as the current. However, a deep reflection and research on the mechanisms and educational strategies used over the years, and its transformation and implementation with highly productive resources, supported by innovative strategies concerning the learning process, necessary becoming necessary the design, development and implementation of specific training programs in educational innovation for the teaching of drawing in the schools of architecture.

Keywords Creative teaching · Architecture · Drawing

1 Towards an Architectural Graphic Creation as a Creative Experience

Without having understood even the consequences arising from the digital environment both social and productive, we have been involved in an economic crisis which has been especially tough in architecture. In this atmosphere it is not hard to imagine that is put in question the appropriateness of the model of architect that society demands.

Do we need to train generalist or specialist architects? Should we prepare future architects to make projects or could they choose other different ways from its very

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educative stage? There might not be a consensus in this regard, but what is clear is that we all agree that an architect should be trained to solve conflicts.

If we move away slightly from the field of architecture, we find that many of these issues are common to other disciplines from the perspective of the university training. We note that, in spite of Bologna, the educational model in this country remains questioned.

Beyond budgetary issues, one of the most frequent ideas affects not so much to the need of transforming the way in which contents are taught, nor even to the contents themselves but to the capacity of teachers and students to adapt to changes as they occur.

This model requires the ability to incorporate and develop new tools that allow a particular purpose, ultimately, key skills that in these circumstances require to be subject to evaluation.

Begins to consolidate the idea of the need for a correct creative learning focused on gaining skills as valuable as the flexibility, the resolution of problems, or collaborative work and so on. All of them are endemic shortages attributed to our current educative model.

Although it may seem otherwise, a plastic learning does not automatically imply a creative learning. This thought has been particularly controversial in the field of Architectural Graphic Expression, in which for decades are faced two competing operating models.

Still, even from the perspective of those approaches closest to the experimentation than modeling, some practices persist which distance to the pupils of the creative experience. In this point the words of the pedagogue Maria Perhaps are very relevant, as she states that "a class of artistic education is not a craft workshop" (May 2014).

Ignoring the reductionist character of the term "crafts", this assertion is clearly applicable, as we know the intellectual processes associated to the visual formalization of an idea or architectural space.

This is not to say that all previous teaching strategies of the architectural graphic expression have been mistaken, but that many of them, that have been appropriate to trigger work processes in the past, they are not anymore in the current time frame.

To illustrate how convenient this circumstance is, we have confronted the aspects which converge in the course of "Drawing, analysis and ideation" (DAI), before and after the implementation of Bologna, in the plans of 1975, 1996 and 2010.

This reflection has allowed us to revisit, gradually, some teaching strategies that were no longer used. Strategies that have been developed for the subjects of graphic ideation, can be extrapolated to other teaching environments as part of a model of creative learning.

Table 1 Subject drawing, analysis and graphic architectural ideation. Comparative of 1975, 1996, 2010 plans. Nomenclature and development, objectives and strategies, human management, results measuring

	Before Bolonia (Plan 1975–Plan 1996)	After Bolonia (Plan 2010)
Nomenclature and development	Plan 1975 analysis of architectural Forms Plan 1996. Drawing, analysis and Ideation 1 and 2	Drawing, analysis and ideation 1 and 2
	Plan 1975 longer term development. (2 topics with 2 courses and 2 semesters each) Plan 1996 reduction of 50% over 1975	Shorter term development. (2 topics with 1 course and 1 semester each)
Objectives and strategies	Importance of results	Importance of the process
	Promotion of individual work	Promotion of individual and collective work
	Limited means of expression. Encoded	Graphic and communicative media diversity, coded and uncoded
	Traditional training of the architect—designer	Broader and more flexible training, according to the new roles demanded by society
Human management	Assessment of the suitability	Recognition of the attitude
	Direct relationship student—professor	Direct relationship of the professor with the group and with the student. Mentoring
Measuring results	Mimetic results searching	Search for relational and communicative results
	Assessment of the particular work of the subject. Specific Training	Valuation of the transversal experiences knowledge. Cross curricular/generic training

2 Creative Learning in the Teaching of the Draw for Architects. A Necessary Change of Strategy

The new conditions of time and organization imposed by the framework of Bologna, have forced us to rethink the teaching drawing understanding this as the essential tool with which to address the learning of the project.

The teaching of design is complex, and uses the draw as operational support and comprehensive/productive tool. It is understood the drawing as the fundamental aspect of figural thought, and the most suitable way for the simulation of architecture. The drawing as a set of possibilities and analog-to-digital tools, involves the learning of a language, but also the assumption of other skills linked to the creative and productive discourse.

When drawing, creativity arises, but also the knowledge and skills which were prior acquired. In the specific case we are dealing with, the teaching of architecture in its broadest sense, involves the learning of a discipline riding between art and technique, which transforms a physical environment to host human behaviors designed with the highest functional, technical and esthetic level.

The architectural project is a simulation of this transformation, by means of the articulation of different disciplines in order to obtain the aforementioned transformation. If we add the need to incorporate new communicative learning in a rapidly changing environment such as the current, we understand that as teachers, we cannot restrict the teachings graphics to a single medium of communication.

The drawing in architecture is today much more than the graphical representation of this simulation. It means analysis, development, communication, transformation and encouragement. In short, is a powerful tool of social interaction.

One of the main features of a creative learning consists in the development of strategies that allow the student to make an adequate use of their knowledge and experience to solve specific challenges. In this specific case, drawing is one of the necessary knowledge to be able to undertake these challenges.

As with other arts, reaching to drawing requires certain skills. At first sight it might seem that, in this educational context, the identification of the creative learning in students by teachers is limited to the scope of the observation.

However in the University context, in which such learning is measured in terms of the acquisition of knowledge and skills, this capacity for conflict resolution and providing solutions, is an active hardly measurable if the intellectual process of the student in the context of the class is extrapolated.

If we determine architectural project as a complex series of acts and reflections focused to the achievement of a race, transformation or solution called “project”, and we define “drawing” as a process against “drawing” as a solution, this means to validate a pedagogy that appreciates the different moments of the creative discourse, opposite to teachings based on the project, in which only the final result of the process as a solution closed and coded is validated.

This is one of the main objectives that clearly has been redirecting in the subject, to value the drawing act itself confronted to the result of the drawing itself. When prioritizing the process against the outcome, we refocus the goals of the subject unlinking them from the specific skill to generate a figurative image adjusted to a specific reality, an unproductive activity from the creative training point of view.

To enter other important aspects in the development of the capabilities of ideation in students, as the capacity of effort, the ability to process the information produced, and self-critic capability, starts a evolutionary learning, which strictly does not depend on a skill that could confine the imaginary development.

The traditional teaching of the arts (also called academic) is still practiced in some faculties and schools around us, basing their learning in the repetition of pre-existing models to reach a sufficient level in terms of representation of that reality.

Although this methodology was not promoting the talent above the ability to put the focus in the result instead of the process, it did contribute to the imagination of the students by working with reference images.

Taking the concept of the need to have references as reliable triggers for creative processes, we can bind with the concept of comparison. In this dynamic, the class behavior as a group that supports this atmosphere for learning through reference models is also essential.

The group must evolve not as a set of individuals that compete with each other to obtain the best result in an individualized manner, but as a working group that allows the flourishing of different talents. In line with the current working modes, should no longer prevail of individual work in the classroom, but a model that encourages the individual results and the work in group.

This way of addressing the dynamics record of group activities, ensures that none of the pupils in the group will be pointed out in a special way. The different rates of learning will be assumed, the different ways of doing will be enhanced, and therefore will be articulated in a natural way a general and collaborative learning that will be able to help progressing to each one of the participants focusing on their needs.

In these various ways of doing, we are giving entry to new media. Drawing is ultimately communicating, without any restriction of code or support. The irruption of digital media puts at our disposal plenty of media and supports that enable this communication that will have an impact on aspects of shape and substance.

The drawing and its learning are no longer restricted to a limited number of media subject to a limited encoding, but supports different media that are due to an undetermined number of codes, new and old. In the action of drawing as a communicative trigger of an inner process, the media should not constitute a restriction but that should facilitate the exchange of views with other partners.

This ties in with the need for a flexible training of the architects designed to meet the new roles that society demands. Compared to the traditional model that betted for an architect designed to work isolated, almost as a craftsman, the complexity of the new projects requires that the architects work in a collaborative way among themselves and with other professionals, with the aim of providing different knowledge, ways of doing and thinking.

This way of working requires an early learning, educating in respect and the adaptation to the different ways of thinking (Sennet 2009).

3 The Management of the Group in a Context of Creative Learning. Productive Variables

What has not changed over the years, is the importance of having students that stand out in any of the aspects of its work. This is a factor that supports this climate of collaborative work and is decisive for the group learning. That is the right atmosphere for a learning without complex, in which the capabilities of each individual can evolve in a natural way to differentiated rates, and on a broad spectrum of students, without which none of them be neglected.

It is important in this regard "to value the attitude opposite to capability", reinforcing the idea that work is the best way to achieve a goal of learning. Picasso said that he did not seek, that he found, relying on a situation of work that influence him to go deep into the creative processes of the artwork, intuitive and analytical processes that at the end of the road are built in a experimental and artistic purpose.

The breakthrough in this “find without intention to seek anything”, notes that is the continued work what is really productive. This fact occurs when you experience actions related to open or speculative experiences and not closed subject to a predetermined solution.

Ramirez (1999) explains making a methodological disgression, that Picasso viewed his pictorial work as a continuous process, an endless happening of variations from a initial issue.

The issue didn’t usually have delimited profiles (it was not clear at what point should be recognized a final form) and glided with frequency toward other adjacent affairs, opposite or simply complementary, existing for this reason a constellation of interconnected works very differently, and not just a single work.

It is this attitude of giving continuity to the own work that allows the discovery, which shapes to a greater extent the artistic thought, above the invention. In relation to this question, Marina (1994) tells us that a distinctive feature of humans is their self-determination.

It indicates that self-determination is only activated by means of projects, that are imagined unrealities capable of organizing mental operations and check the behavior toward the early ending in the project itself. And for that the relationship between teachers and students in the context of the class work, must change in anticipation of the models of cooperative work that society demands.

In the same way that students should be able to rely on the teacher as a figure of control and validation, progressively the group should be given ever more relevance. The students must be incorporated to the critical debate. The traditional relationship between the student—professor, has to be replaced by a more open relationship between the members of the group.

Is being developing a work of empowerment of the students, in which certain members of the group share with professor tasks of discretion. It is finally imposed the need to improve the overall outcome of the class beyond the individual, believing that the greater the variety of proposals, more rich is the debate and more references can be obtained.

It is a certain turn of nut on the concept of mentor, that instead of being exercised in an individualized way (i.e. a student emphasized assistance to another further behind), is a part of the group that exercises this influence on the rest.

4 Processes of Evaluation and Measurement of Creative Learning

One of the problems that often arises when implanting the creative learning, refers to the correct measurement of the results. Earlier, we mentioned that one of the handicaps that pose this type of teaching, has to do with the lack of indicators for measuring it, which causes that, in many cases have chosen to resort to comparable results instead of promoting the search and space exploration itself whose gradation is more diffuse.

This is the circumstance which has led in the past to base the learning of drawing on the search of mimetic results, instead of searching for open results that allow the communicative interchange and a further track of additional experimentation.

It is surprising as the variety of referents is positively translated into experimentation processes of the students. Such a systematic exercise as a searching for visual references related to the particular interests of each student, becomes a measurable indicator that influences its work processes.

The student is not duplicating a model without going any further, but tries to decrypt a structure of thought that encourages him to finds his own track. This self-finding of the working process is perfectly evaluable.

By identifying the graphic processes of the architectural drawing and architectural design as processes of scientific research methodology, we can validate situations resting on the inferences to build visible realities with a certain degree of uncertainty and uncertain conclusions, to validate in a remarkable way the method applied as a fundamental content and not the conclusion (Raposo 2010).

These kind of dynamics require a certain flexibility and effort on the part of the teachers in the approach of the teaching strategy, allowing students to explore different possibilities and activities linked to their capabilities, at the same time that teachers deepen in areas of personal interest for students in search of the proposed processes in the dynamics of class.

Insisting on the fact that those are roads of a great personal value in the explorations carried out, and of course, validating the exchange of ideas in search of the existence of more than one solution to the problem, it is important not to disassociate the class work of the personal experiences of the students in validating the work.

Project is a provocation, a step into the future. Born of an obsession, of a vital purpose very clear and assumed, as Argan (1969) says. It is almost a necessity, which connects with this attitude that must be in continuous movement and dynamism, for which events occur and translated the traces of what is produced.

5 Instruments and Procedures of the Creative Learning in the Teaching of Architectural Drawing

Before going on to describe the sample of the study, it may be contextualized what is understood as “drawing as an instrument for the project” in the subject of “Drawing, Analysis and Ideation”. It is necessary to specify that the singularity of the architectural project, resides in the spatial character of its speech. The architectural drawing and no other, is the ideal system of contextualization of the space of the architecture.

Included in the first year of the Degree in Foundations of the Architecture of the ETSAM, subjects DAI 1 and 2 are conceived as two workshops of 6 ECTS each one of them, which are taught in continuity (DAI 1 is provided in the fall semester of first course and DAI 2 in the spring). In these workshops, the students address the processes of architectural creation in its different moments of generative thinking and understanding, through the use of the graphic language.

The drawing, collage, 3D model are essential tools. Perception, expression and internalization are associated in the movement and the action of drawing (Armstrong et al. 1995). Under the tutelage of three teachers per classroom, the course is taught in a range of between 60 and 70 students. Not only they have to acquire the competences contained in the program of the course, but must begin to develop its "imagination" focusing to the field of architecture.

Through the development of the course's exercises of the course the verbal capacity/linguistics, body/kinetics, and visual/spatial are articulated adequately. On the basis of the theory of Multiple Intelligences of Gardner (1995), each person can develop any of the nine intelligences or cognitive skills, being in this case, three of the nine, the most suitable for a learning supported in the generation of artistic processes, so that the students have shown skills, dedication and specific creativity in these particular areas.

In spite of the fact that the evaluation is continuous, each one of the courses are divided into 3 cycles of learning in which the student goes deep in the active processes that are involved in the architectural and spatial creation.

In the first weeks of course, a time in which imparts the cycle 1 of DAI 1, the work consists in generating a minimum visual imaginary/ideology in the students, using a set of trigger images. All this must involve a greater flexibility in teaching at the contents to transmit and a dynamic that enables open processes of research and communication (Fig. 1).

At that time we jumps into the Cycle 2, which gets deep into what you have learned by addressing the approximation to the space from physical decontextualized models. From our point of view, the cycle 2 is relevant to the learning of the drawing as preparatory tool for a future project.

In these moments the students have lost the fear to white paper and are already able to cope with work in a more direct manner. At this stage, working with serialized developments in which triggers are being replaced by the own images of the students.

During this cycle, the dynamic of the class becomes more intense. We begin to generate synergies between some of the students of the group and the teachers who start sharing common perspectives in relation to the space. At the end of this cycle, the acquisition of skills in the representation is in the background compared to the dynamic fact of architectural drawing (Figs. 2, 3).

The Working Group seems to be more involved, emerging students who stand out for their desire to continue the research into their own processes. It is the moment in which the class begins to generate an atmosphere of healthy competitiveness.

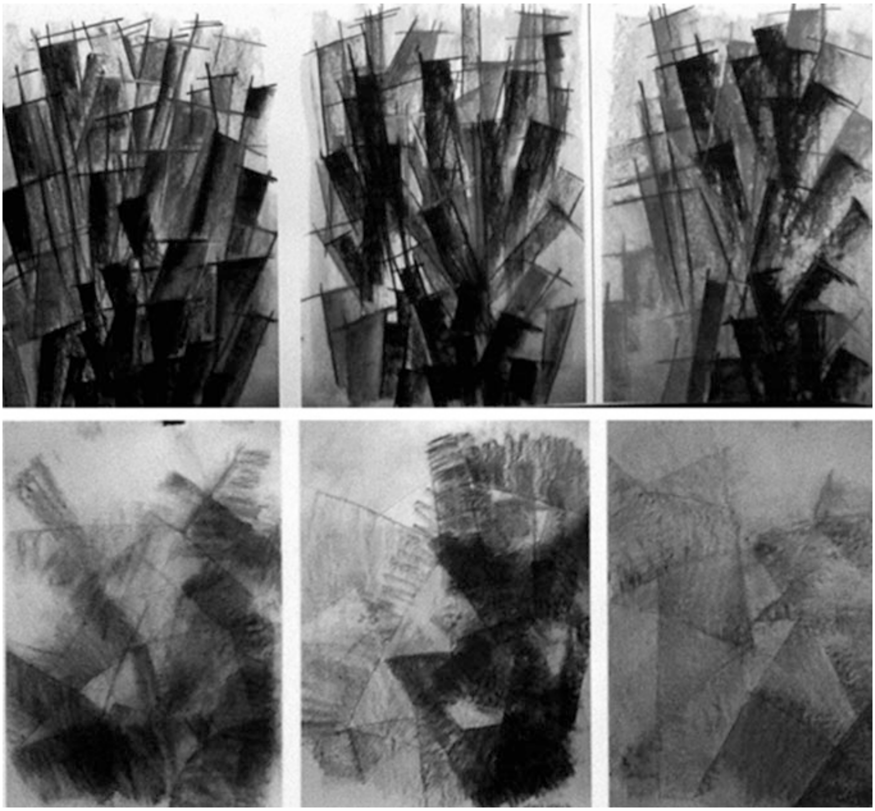

Fig. 1 The graphics as an autonomous language. Summary graphic series of educative cycle. Course 2013–14. Cycle 1. Subject DAI 1

In this regard, the cycle 3 acts as a conclusive agent of the previous cycle. Introducing some complementary variables to work already developed.

Pupils are invited to share the space of the classroom to continue to develop processes that will lead to the creation of spaces. While as in the earlier cycles is a single job, the media used favors the collaborative exchange between students in the group. Critical thinking is shared and discussed among students with different results, at the end the context of the class is improved.

In spite of being two subjects, learning in DAI 1 and DAI 2 are still understood as accumulative. Unless little exceptions, is usually given the fact, that the group will count with the same teachers and students.

DAI 2 continues to be in the format of three teaching cycles, that address the job from three progressive scalar approximations. As in the previous semester the proposed exercises are carried out in an individualized manner, but there is a large part of the job that is also undertaken in group.

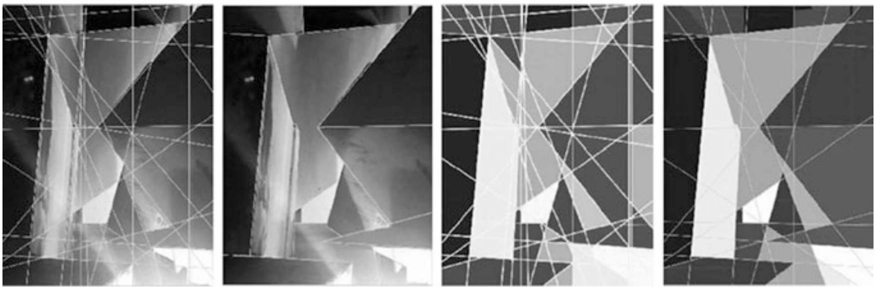

Fig. 2 The graphics as a mediator of visuality. The graphical construction. Intentional framing. Course 2013–14. Cycle 2. Subject DAI 1

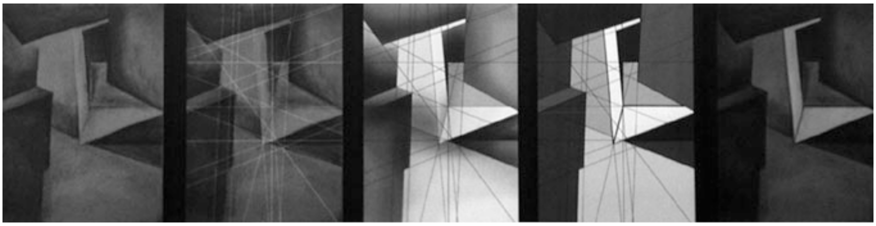

Fig. 3 The graphics as a mediator of visuality. The graphical construction. Intentional framing. Course 2013–14. Cycle 2. Subject DAI 1

A proposal for a cooperative work that is structured as an association between students in search of mutual assistance for the implementation of joint activities, so that they can learn from each other. In contrast to DAI 1, the students are working with a real urban area as an imaginary trigger. The city as a space of dynamic relationships, the transformation of the structures of the city, as a texture in permanent transformation.

In the first cycle the students address individually the architectural project from the control of the first phases, the envisioning creative-architectural imagination. All project is born of an imaginary-intentional and interpretive act of the reality. The origin of the architectural way as interpretation of the established order (Fig. 4).

In this cycle the production phase is reduced to the graphic-comprehensive process of "giving shape to the idea" with the most significant radicalism and the less formal commitment in the final proposal, expressed and symbolized by the direct use of the architecural elements without formal reinforcement (qualities and spatial concepts).

In the second cycle, developed in groups of no more than 4–5 students, the students deal with the Architectural Project from the phase of processes and

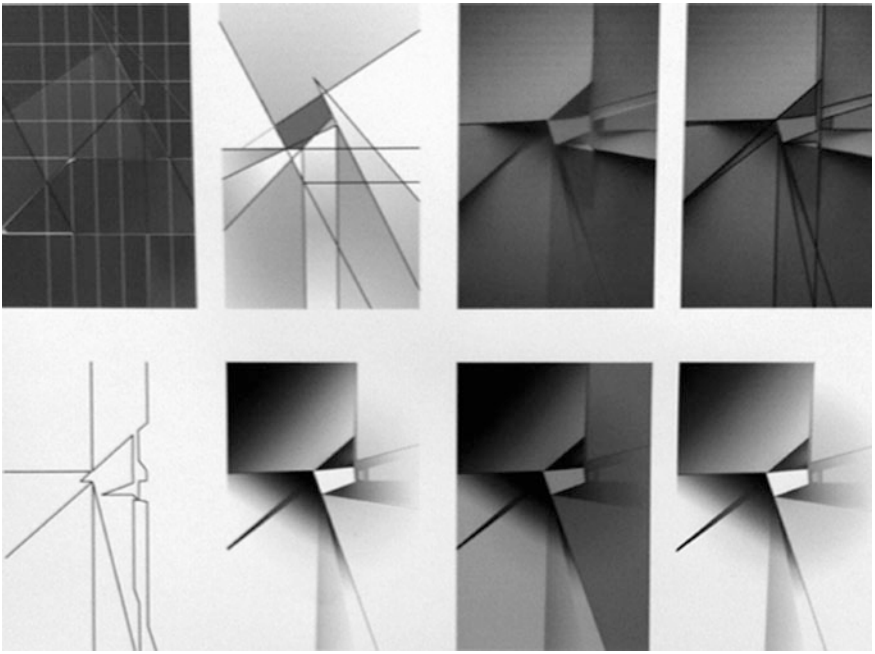

Fig. 4 The graphics as analytical and conceptual language. Interpretation of architecture. Course 2013–14. Cycle 3. Subject DAI 1

production-architectural transformation. As in the previous cycle, we deepen on the idea that the project must start from the control of the creative phases, whose ultimate aim is the construction of the architectural object" (quantity, proportion and spatial metric).

At this stage, the work of the different groups is contrasted with among themselves. Initially the area of the city was addressed from the territorial perspective. In this moment it is divided into several sectors on which students will work together and in an individualized way (Figs. 5 and 6).

Not only it is proposed a scalar jump to adjust the drawing tools at the detail that the new representation requires, but also the groups may keep in mind that each sector must necessarily interact with the surrounding ones. In other words, their analytical interventions applied to a particular sector must contemplate the continuity of the elements of the zone that is shared with the neighboring sector without renouncing their own expressiveness. The class has to operate as a beehive (Figs. 7, 8, 9 and 10).

When addressing the third cycle after Holy Week students will individually review the analytical interventions made in the first and second cycles. The aim is to

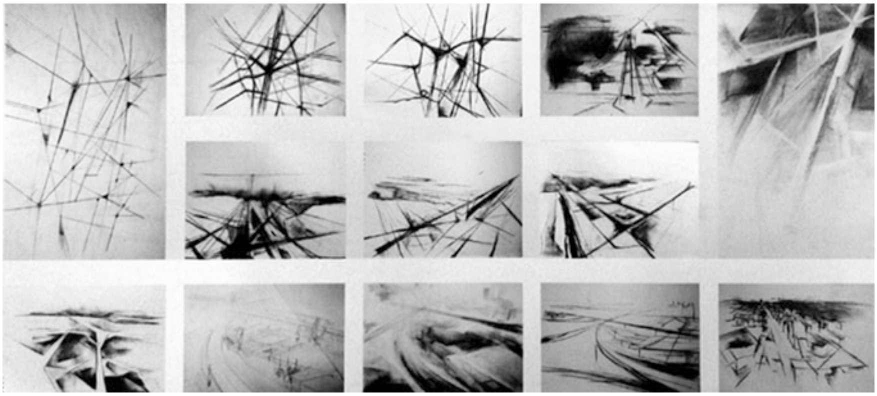

Fig. 5 The origin of the architectural form. Qualities of the territorial space. Course 2013–14. Cycle 1. Subject DAI 2

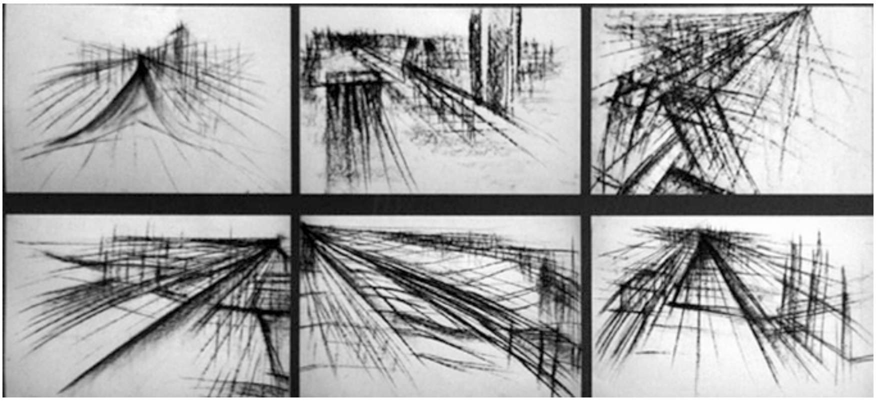

Fig. 6 The origin of the architectural form. Qualities of the territorial space. Course 2013–14. Cycle 1. Subject DAI 2

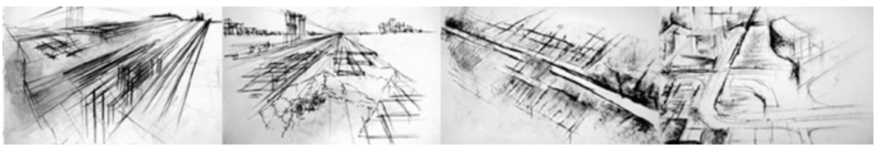

Fig. 7 Architectural production-transformation processes. The construction of the architectural form. Course 2013–14. Cycle 2. Subject DAI 2

Fig. 8 Architectural production-transformation processes. The construction of the architectural form. Course 2013–14. Cycle 2. Subject DAI 2

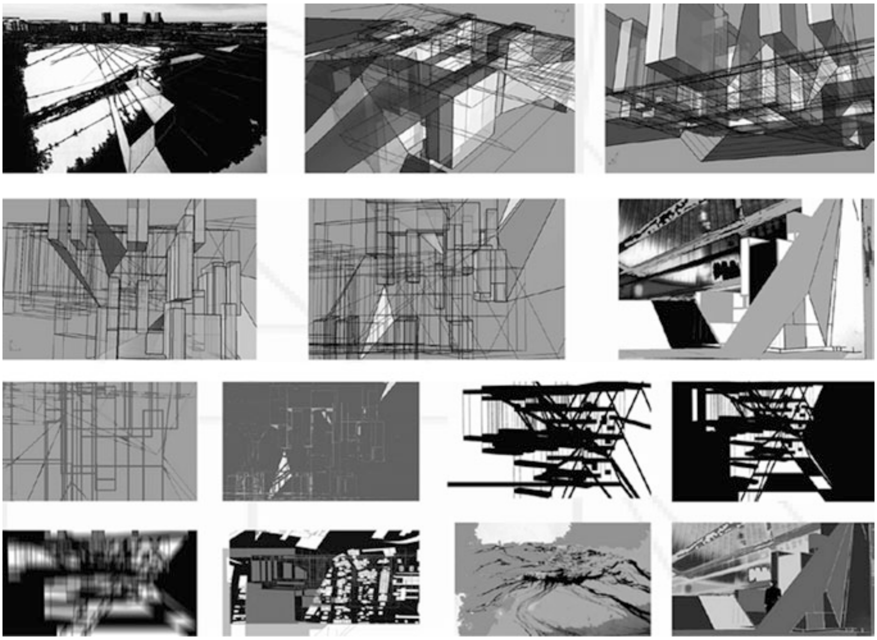

Fig. 9 Synthesis Imagination-Transformation-conceptualization of architectural form. Proposal territorial space. Course 2013–14. Cycle 3. Subject DAI 2

develop a personal proposal of architectural character, in which each student will define with total freedom a programmatic development, scale and location, within the environment worked during the course.

While this is the most exciting challenge phase for students, is usually not the one that generates the most successful results.

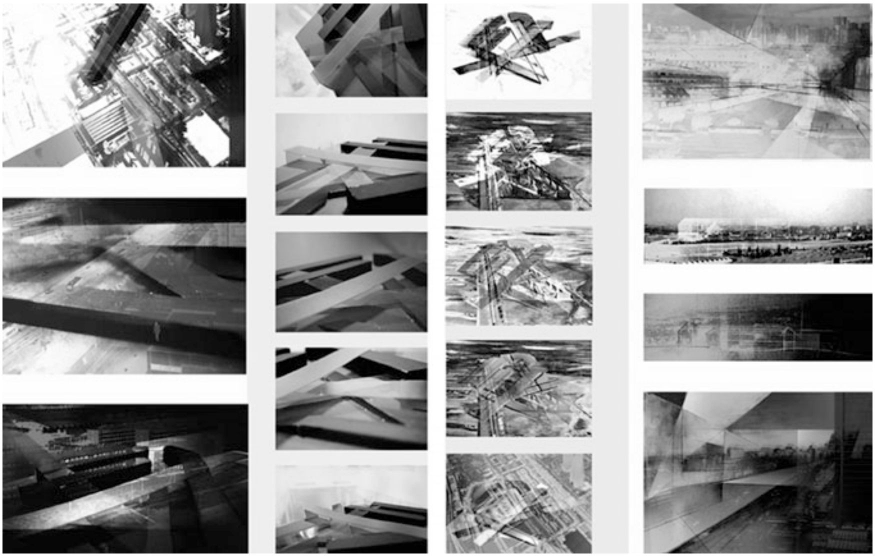

Fig. 10 Synthesis Imagination-Transformation-conceptualization of architectural form. Proposal territorial space. Course 2013–14. Cycle 3. Subject DAI 2

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Representation of Natural Light in the Architecture Project: From Graphic Abstraction to Computer Simulation

Edgar Alonso Meneses Bedoya and Javier Monedero Isorna

Abstract The representation of natural light is placed in the context of architectural drawing, showing that despite the leading role of daylight in architecture, the representation of its phenomenology was limited to the geometric layout of the shadows in space; however, with the addition of IT technology and virtual simulation, this representation takes on a new communicative dimension through the use of realistic images that can represent phenomenology light as it is perceived and assist the architect as an instrument for the correct representation of natural lighting and support for the development of an energy sustainable architecture.

Keywords Natural light · Simulation of natural light · Light representation

1 Representation of Natural Light in Architectural Drawing

Representation has played an essential role in the development of the architectural project since it is the one allowing the project to formalize by means of the graph, which grants a visual image of the idea and accompanies its development process until its materialization. According to Ricoeur ([1995] 2004), there are three moments in the project narrative, named by Ricoeur as triple mimesis: prefiguration, configuration and reconfiguration. For these, according to Ruiz (1999), there exist specific types of drawing which characterize that narrative moment of the project, and make possible the degree of graphic communication needed for its

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development to settle; those moments are: the conception drawing (outlines and sketch), the precision drawing and the communication drawing, respectively.

At these three moments and according to the types of drawing taking part in the visual communication of the project, the representation of illumination must adopt different expressions, which can be determined by the techniques used and by the function acquired by the graph for the project definition.

Therefore, during the conception of the project, the superposed spots and lines resulting from gestural line sketch create abstract graphs of the ideas of light in the space or place, which do not jeopardize the relationship of the idea with an analogical or mimetic image. On the other hand, the architectural drawing, with its precision and strength, must show the influence of light on the surfaces of the space elements, thus allowing to shape the project more accurately. Lastly, in the project communication stage, images in perspective that show the space reality of the project take place; these images must lead to the understanding of the luminance phenomenology and its impact on the visual perception of the space, thus making possible the valuation of the space qualities.

Unfortunately, in spite of the graphic wealth resulting from these different expressions, it is observed that—through history—architectural drawing has suffered from a strong limitation in its ability to represent luminance phenomenology, which has had a negative influence on the evolution of techniques and methods used by architects to represent the light qualities of the project, these being restricted almost exclusively to the geometric representation of shades of volumes in space.

One of the elements that have impacted this limitation the most has been the confrontation the drawing and the pictorial have been subjected to through the history of architectural representation. In this theoretical and practical debate, the representation of illumination remains as a subject to be treated by pictorial techniques, taking into consideration that such techniques refer to the representation of the phenomena that take place at the body surface (the mass), and this representation also deals with the apparent aspects of the object, which is the opposite of the architecture line drawing that allows to control the geometric aspects of the object, thus focusing on the "true" representation of the project.

This debate could be traced back to the time of Alberti (1452), who in his treatise De re aedificatoria (Ten Books on Architecture) emphasizes the need to draw the project from the architect's position and not from the painter's since, according to him, the painter tries to show the effects of the shades, while the architect emphasizes the true description of the project, not with apparent views but with true lines and angles. In this same vein, Florido (2001) cites Heinrich Wólfflin, who in his text Kunstgeschichtliche Grurndbegriffe (1933) (Fundamental Concepts of Art History) expresses that the division between the linear and the pictorial responds to two attitudes in the face of the world that are essentially diverse: "There (talking about the linear), the steady and precise figure is preferred; here (talking about to the pictorial) the changing phenomenon; there, the permanent, mensurable, limited form; here, the movement, the form in function; there, things themselves; here, things within their connection" (Florido 2001: 17).

According to Jorge Sainz (2005), along with the development of the treatise of Descriptive Geometry developed by Gaspar Monge in 1798, the "scientific" outline of shades in the architectural drawing is fulfilled, which led the intuitive and mimetic reproduction of painting to be replaced with geometric procedures, which —in theory—allowed to generate "more real" images and to get data on the third dimension. For Sainz (2005), the notion of "drawing" is then replaced by the notion of "planes", understood as an instrument or procedure allowing to dominate the authentic truth of the geometry laws on which architecture is based.

Thus, the architectural plane adopts an expression of the illumination in the space that moves away from the realistic image, understood as the image that gives the maximum of relevant information about reality, that is to say, easily understandable (Aumont 1992: 218), forming an abstract image. This image describes geometric qualities of the space and the exclusive effect of the ray or shade on the planes that limits the space, reducing the expression of the luminance phenomena to geometric outlines that do not offer further information about the other effects of light behavior interacting in the space, such as: brightness, shadows, reflections, transparencies, among others. This limits the generation of an image that shows the reality of the project just like it could be visualized by a user lost in this space.

This graphic limitation could indicate the omission by the reflection of the illumination impact in the space through the development of the project in architecture history. This is due to the fact that the exclusive graphic representation of shades in the project is insufficient to accurately transmit the apparent and sensitive reality of the space and the architectural object qualified with the light presence, which can be seen in the few graphic referents that allow to identify the way the precise representation of variables affecting light behavior in space were approached, variables such as: position of the luminance source, space orientation regarding the geographic north, light intensity, light color and physical properties of materials in the space.

2 The Role of Digital Simulation in the Representation of Luminance Phenomenology: Two Production Approaches

With the implementation of computer science technologies for digital graphic representation, the possibilities of representing light phenomenology in the space have significantly increased. These technologies replace manual procedures with digital graphic processes and calculation of virtual simulations, which allow to represent light phenomenology comprehensively, generating more accurate and faster results, which can be adjusted to the variables of analyses wanted by the architect.

With the introduction of these technologies, there is a move from action of representation, focused on the visual aspect of the represented objects, into digital simulation action, which is understood as a series of computer processes that allow to evaluate the behavior of a system—existing or proposed—under different configurations of interest and for a certain period of time (María 1997). Understood this way, simulation implies assuming a new attitude before objects and phenomena in order to obtain their representation, since in the virtual world, objects' characteristics respond to "mathematically programmed behaviors" aimed to imitate the complexity of physical reality, the image representing them being the product of the interaction of relations established between these phenomena and objects (Martens 1999).

From this point of view, illumination simulation in a space poses a deep methodology transformation regarding the traditional representation. Now not only the apparent aspects of the reality that is meant to be represented are of interest, but all the physical aspects of the objects configuring the space, as well as the precise knowledge of the luminance phenomenology, must be considered. Representation in this technological context is no longer exclusively focused on producing a "mimetic" image that graphically describes a space condition, but it generates "data" that can be interpreted through different options of graphic or numerical visualization, according to the "means" chosen for their presentation. This way, there is a move from the limited "representation of shades in space" to an "information production" scope that expands the possibilities of generating and analyzing the data needed to evaluate the luminance conditions in the space and of making decisions based on truthful and accurate information.

The contribution of simulation for light representation in architecture goes from the realistic visualization of the space, which involves complex calculations to represent all type of diffuse and specular reflections, refraction, cutting effects and diffraction of light, to the possible quantitative analyses thanks to the calculation of the luminance levels, the amount of hours of day light available and the visual comfort, which constitute essential elements for the analysis and representation of lighting conditions of the space framed by the current architectural production.

These possibilities are obtained thanks to specialized programs whose development has resulted in two different tendencies or approaches: qualitative and quantitative. The qualitative approach, inherited from the entertainment industry, is oriented toward the representation of the apparent qualities of light in the space from virtual scenes that show the spaces as they would be visually perceived by their users; and the quantitative approach, whose use stands out in the engineering area, looks for collecting precise data of the luminance levels present in the space from complex algorithmic models (Bryan and Autif 2002).

Despite this differentiation, computer advances in both approaches have been focused on the development of mathematical algorithms that allow to accurately describe and calculate the behavior of the luminance phenomenon in the space, knowing that it is the factor that mainly provides realism to the digital image and precision to the calculation. Among the important advances, the development of complex models and techniques stands out for the calculation of global lighting:

Radiosity, photon mapping, Radiance, the uses of IBL–Image-based lighting–, Metropolis Light Transport, Point Clouds and Point-Based GI. Such diversity of algorithms and techniques has led to the birth of countless programs in the market. Unfortunately, they do not always offer the levels of precision required for lighting calculation and realistic simulation. Facing this technological uncertainty, scientific communities have undertaken important projects of computer programs validation, from which "Solar Heating & Cooling Programme" stands out. It has been led by the IEA (International Energy Agency) since 1977, along with many research works by academic groups.

A large part of these research works base their methodologies on the comparative analysis of data taken from different sources; the most outstanding ones are those that conduct evaluations between the measurements in a real space and simulations carried out with specialized programs. These validations have allowed to demonstrate the programs' potentials and limitations, highlighting Radiance as one of the most accurate and most widely used for the simulation of natural light, considering that more than 50% of natural light calculation programs are based on it (Andersen et al. 2008).

For the visual simulation, it is observed that research searching to evaluate realism in the digital image is scarce, which could be justified by the fact that the interest on the project's visual aspects has been pushed into the background because of the quantitative approach supremacy. From this perspective, the validation project led by Reinhart and Breton (2009) can be highlighted; they have demonstrated that the program Mental Ray, on the Studio Max Design 3D platform, allows to generate realistic images resulting from precise calculations similar to the Radiance calculations.

Unfortunately, the differentiation in these two approaches has generated difficulties for the implementation of these technologies and their effective integration in the work flow of the design process. One of the main difficulties has been the necessity of duplication of the scene preparation and calculation processes according to the type of approach of the programs used, since there is little compatibility between the input information required by each program. This adds to the requests for advanced knowledge on tools management and concepts about light behavior in the space, which often overflow architects' and designers' capacities (Panitz and Garcia-Hansen 2013). On the other hand, the diversity of programs found in the market, which do not produce accurate information according to users' needs, faces them with great uncertainty on the validity of obtained data and on their usefulness to support the decision making.

In order to overcome this and other difficulties, it is necessary to understand that the act of "simulating illumination" has turned into an area of knowledge that demands its own theoretical and practical concepts, in which the qualitative and quantitative aspects of light converge in the same action, looking for the improvement of the project's representation practice. This is obtained only if an illumination simulation practice is configured, in which technologies (programs and equipment developments) are focused on an approach that promotes the "realistic configuration" of the calculation scene, in direct opposition to the "scenographic configuration".

3 Teaching Light Representation in the Comprehensive Formation of Architects

In order to reach a suitable positioning of illumination representation, it is essential to create a scenario of architect formation that tends toward the recognition of the role played by light representation in the contemporary project development, since beyond the important contribution made by the formation in descriptive geometry for the outlining of shades, it becomes necessary to recognize that illumination in the architecture project is a complex element to solve, involving essential aspects of the project, which needs accurate and nimble instruments that allow to approach the proposed solutions in a comprehensive way.

In this formation scenario, it is found that the division of the two mentioned approaches for the use of technologies still remains, which is shown in the existence of academic subjects oriented towards the teaching of computer technologies for the virtual representation of the project and the generation of realistic photoimages of the spaces. On the other hand, there are also academic subjects that deal with the technical solution of aspects related to the calculation of illumination, visual comfort and the advantage of solar light, for which simulation constitutes an essential tool for the decision making about the project.

In such division, it is also observed that the greatest impact of simulation technologies has been related to the area of digital representation of the project; however, it is in this very area that the strongest criticism have been done to its implementation, since—unfortunately—they have been used to generate images showing the apparent qualities of the space, from all type of digital retouching that deprives the image of its capacity to visually communicate a “possible state” of the project. Academic detractors of the use of these technologies justify themselves with the argument that in render visual aspects of the project are prioritized on its architectural and space qualities. This position places us again in the debate that faced architectural drawing to painting, this time associating the generation of realistic render to the painter’s attitude that emphasizes the apparent aspects of the project, where the “how it looks like” is favored over the “how it is”.

This debate is urged also by the unfortunate conceptual and practical confrontation between virtual Simulation and traditional Representation. This debate counts on a group of academic and professional people who bet on simulation process within a scenario of technological production that advances on the computer graphics development, opposed to other groups rooted in a traditionalistic practical conception of architecture, focused on the manual production of the architectural drawing, as the only instrument able to accompany the creative and conception process of the architecture project. This has led to the fact that in some academic scenes the duty of teaching and practicing simulation has been delegated to subjects of instrumental nature related to computer-aided drawing. On the other hand, the use of technologies associated to the calculation of luminance levels become highly relevant nowadays because the architecture project must respond to the new regulations and international policies for the planet’s sustainability.

This is according to Mao-Lin Chiu (2006), who points out that since early 2000, the use of computer science technologies has increased, which is motivated in the fact that current architectural practice is being led by aspects related to environmental conservation (sustainable architecture), technological innovation and creative design.

Facing this, the project practice, along with the representation of the project, must be transformed to involve the computer technologies for simulation, so that the generation and management of the information needed to validate the project and its effective answer to all the conditioners is reached.

Unfortunately, energy analyses are not widely considered in the central teaching of architectural design; therefore the use of these technologies is not directly linked to the design process but is relegated to the technical subjects that deal with general concepts of sustainability and calculation or simulation methods. The Latin American case, studied by González and Trebilcock (2012), seems critical, since only 7% of 594 curricula of Latin American universities had a direct integration of sustainability contents to the projects workshop. Adding to that, it is clear that the distancing between the training processes in the projects workshop and the fundamental knowledge taught in the representation and computer courses still remains. This is according to Dokonal and Knight (2008), who declare that in most faculties teaching is strictly divided into design teaching and computer knowledge teaching.

For Toth, Drogemuller and Frazer (2010), using computer technologies for simulation must not only be linked to the project process; it must also be addressed from the early stages of formation and development of the project. That is because the consideration of the aspects regarding sustainability and energy saving must be addressed from the first stages of the project, by doing preliminary analyses of the building behavior before the main characteristics of the construction are set.

The delayed implementation of these technologies into the architects' formation process prevents from strengthening their use as design instruments. Pla-Catala (2013) notices that it is not advisable to teach/learn these technologies at the end of the curricula—as it has been traditionally done in architecture schools—through specialized courses or workshops of complementary formation. The author points out that the challenge for teachers is to manage to leave the instrumental idea of digital technologies behind.

It is important to understand that digital techniques are a way to reach a more important goal: design, and that they are not a goal in themselves. That is why curricular integration must contribute to reach the interaction between the means and the goal of design that is pursued. This is the reason why approaching the simulation of illumination must contribute to the unbiased revision of the project in the quest for its perfection and not be limited to show suggestive images that do not accurately communicate the characteristics of the project. This must be learned from the first years of formation, as it is the only way to transform technologies into an instrument of thinking in accordance with the current technological moment.

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Traditional Drawing and "New Drawing": Reflections on the Role of Representation

Carlo Inglese and Luca James Senatore

Abstract The contribution, starts from an analysis of the procedures and graphics performed on the survey of San Bernardino in Urbino, proposes a reflection on the current role of traditional drawing and on the role played by the "new drawings", that is, the different types of graphics that are possible to create from the survey data. From the processing characteristic of the "new drawing", this paper analyses the contribution to knowledge given by those commonly known as images Gigapixels and the subsequent processing of these kinds of data.

Keywords Drawing · Survey · New technologies

1 Introduction

The representation of architecture has always played a dual role: on the one hand it has established itself as a tool to describe information from the real world and the other as a tool for analysis, of the understanding and interpretation of the reality.

Both these aspects are characterized by an high level of discretization and subjectivity, and therefore are an important critical contribution by whom was called to represent the information obtained from the reality.

The advent of digital technology and techniques that make use of non-contact instruments (3d laser scanner; massive acquisition systems of photographic data, image based modeling systems, etc.) allows the creation of representations with the highest level of detail, through automated methodologies entirely uncritical in relationship to the information data acquired that, precisely because of their potential for knowledge, can be called "new drawing". Among the elaborations that

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are part of this typology, the contribution analyses the contribution of knowledge obtained from what are called Gigapixel images.

The quality assumed by these uncritical charts is an important element of study precision because of their ability to represent what otherwise traditional techniques are not able to show: in the end who uses modern technology no longer can ask themselves when critically faced with an object, but must be able to return, in digital, as much information as possible with the lowest level of uncertainty.

Because of a new critical rereading and possibilities offered by this technology, the contribution tries to solve a misunderstanding that still exists in the practice of architecture: whether it be traditional representation, the drawing, whether it's a digital representation of data, the "new drawing", both are generally (and incorrectly) defined "representations", without highlighting what can be considered for their critical contribution to knowledge and what are exclusively the transposition, digital, data from reality.

If it is important to make critical reading operations such as analysis of the materials or of the degradation, only the design does not allow these operations, or allows it as a conventional data, but with the massive acquisition of data-based methodologies, and the "new drawings", an objective reading of the data can be obtained. On the contrary if it is to carry out studies, generally with proportional or interpretative metrological (formal, spatial distribution, etc.) the design expresses all its value, because it is with the process of the drawing that materialize some prerogatives of the detected object not otherwise detectable.

Regardless of the digital technologies and the equipment used, today there is a clear difference between the design that continues to be an instrument of interpretation out of scale and "new drawings" which is the result of data obtained by digital technologies.

2 The Survey

The survey of the Church of San Bernardino (Festa 2003) (Fig. 1), which is the subject of this article, was aimed at creating descriptive and interpretative drawings with different scales of representation in order to obtain the necessary graphic support for the operations of consolidation in the Church, as well as a thorough analysis of masonry equipment and technical-construction components (Note 1).

Having regard to the objectives, and to get the best metrics quality, it was decided to proceed through an integrated survey using high-technology equipment according to the operating modes extensively tested in our Department[1]: laser scanner and topography for the given metrics; high resolution photography for returning the material aspect of the building.

[1]About this: (Bianchini 2001; Bianchini 2007a, b; Docci 2005, 2007; Inglese 2012; Docci and Maestri 1994; Senatore 2011, 2012; Bianchini and Inglese 2010)

Fig. 1 The church of San Bernardino

Two separate detection campaigns have been planned with the aim of creating drawings of the architectural elements of the building to be considered the most significant.

With this work programme in the first survey campaign the focus was on data capture methodologies suitable for the graphic representation of the elements which offered an overview of the external surfaces (in the ratio of 1:100–1:50), in order to define the main formal and geometric characteristics. The first phase had the task to act as support for the exact location of the details, performed in the second stage and were needed to document the construction solutions, the forms and the conservation status of the most interesting parts of the monument.

In the second phase, it was carried out a close examination of the survey, employing methodologies capable of producing drawings and "new drawings" that then were able to return information on scales (from 1:20 up to 1:5) best suited to the study of the details, particularly with regard to its main entry portaland and a column, with bases and capitals in the internal order, under the dome of the Church.

3 The Survey Techniques

3.1 Topographic Survey and Long Range Laser Scanning

The first phase was dedicated to making a topographic survey to identify a number of points of known coordinates, chosen by the operator for their metric and formal peculiarity, and to create a network of control points, over which anchor the point cloud obtained with laser scans. In total they were beaten about (Note 2) 300 points on both exterior and elevations and on those interiors, also including the dome,

Fig. 2 Laser scanning of the church

making the stations on four different positions previously selected, in the interior under the dome, and outside one for each prospects, in central position.

The points acquired with the topographic survey are decided, in the process of restitution, where known or targetds for the registrations of data (the union of individual point cloud made with laser scans) (Note 3).

The first phase of survey was completed using a 3D laser scanners long range, by doing no. 6 general scans, comprising two targets per scan, with a Sample Spacing of 10 × 10 mm. Figure 2 the laser scanner was used, in this case, as a total station, by setting the spatial coordinates of each station, so it was possible to make a network of geotagged points during the survay. This has produced a huge amount of data because the topographic network already constituted a sufficiently able to form a pattern to the registration of individual clouds, however this setting has helped to contain the average errors to around 1 mm (Note 4).

3.2 High Resolution Panoramic Images

The second phase of survey conducted on the Church aimed to deepen and integrate the knowledge of the part of the monument with a detailed survey operations using a laser scanner 3D short range and to acquiring high-definition panoramic images through which to investigate the product in high detail (Note 5).

High-definition panoramic images, known as Gigapixels, were carried out using a full-frame camera mounted on a motorized pan and tilt head. In order to garanty the metric quality of the image Gigapixels, before the acquisition fase, it was necessary to calibrate the metric value Center of rotation of the head with the center of projection of the lens (Entrance Pupil). The calibration was made in the

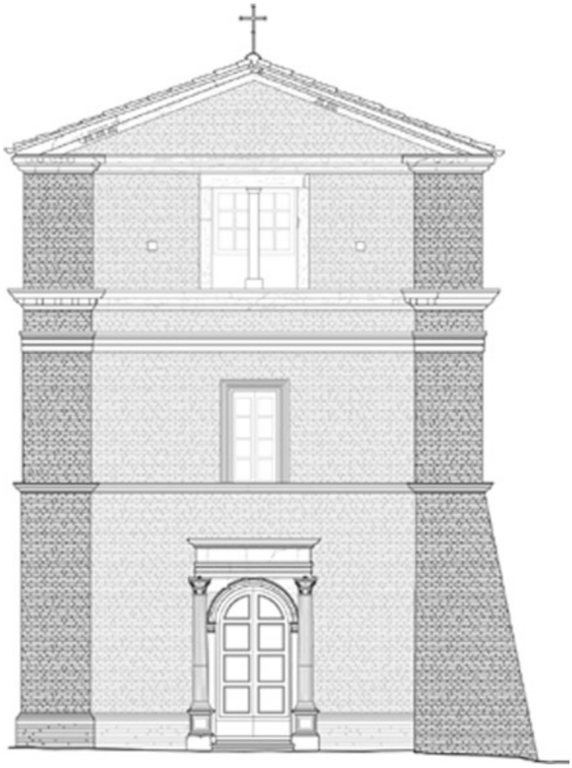
Fig. 3 The photoplan resolution of the east façade

laboratory through the method of finding the position of the Entrance Pupil for the different values of focus used later while shooting (Fig. 3) (Note 6).

3.3 The Survay Through a Traditional Reading of Digital Data

Once obtained a numerical (Note 7) model through a preparatory stage of registration of individual points cloud throw a recognition of targets, it was decided to proceed making three main general 2D quoted drawings of the three elevations at the scale of 1:50, which were to form the basis of the total knowledge of the monument and the reference for the extension work. The realization of the drawings was done through restitution through critical representation of basic information obtained from different instruments to a certain scale, using a digital technique but akin to traditional analog techniques. Although simplified compared to the past, in relation to the overabundance of information derived from reality, this phase is still

Fig. 4 Return to the section of the north



an important moment of analysis and critical understanding of the artifact, with an important and indispensable subjective input by the operator to identify the characteristic elements of the monument (Fig. 4).

3.4 "New Drawing"

At the time of having to produce detailed drawings differently than the General stage, became a much more structured use of the data obtained from various instruments and in particular by the high resolution photographs (Note 8).

The image editing software created images Gigapixels in size for each exterior elevation varying between 10 and 20 GB. For these images, by using tools that are integrated into the stitching software and with the support of topographical data, it was possible to locate the position of the main floor (with a thickness of 10 cm uncertainty) for each elevation, in order to scale photomaps 1:10, 300 dpi resolution reduction, which formed the basis for the architectural details (Fig. 5).

Fig. 5 The photoplan resolution of north

Given the nature and the building quality of the product, this stage was mechanical and repetitive, leaving few interpretive interventions by the operator. Precisely because of the difficulty in identifying structures that needed interpretation, the result of the study has given drawings that are fixed in their formal establishment, but limited to matters relating to the number of necessary information to the study by the final operator.

The quality of the processing, and in particular of gigaphoto geometrically correct, showed a series of extremely important information that for graphic reasons it was not possible to return at the appropriate scales. Simplified management of this information, as well as the possibility of a geometric control of information they provided showed clearly how these elaborations uncritical, these "new drawings", can be used by any scholar in the analysis of architectural artifacts, certainly more correct than that which can be obtained from their analysis of an artifact critical rereading through the traditional draw (Fig. 6).

In particular the phase of graphic representation is a very important moment of synthesis not only for processing of the data acquired but also to extract from the data the information, to varying degrees, necessary for the understanding of the building. This is the case of the restitution of three major elevations, quoted in scale

Fig. 6 Analysis of the level of detail attained by high resolution photography

Fig. 7 The photoplan resolution of west elevation

1:100–1:50, integrated with the full resolution photo-plans, processed in digital version and navigable, which have been used for the first reading of the building. In fact, from these restitution it has been possible to verify that the external surfaces of the Church consist of a regular brick facing head-cutting-head at all levels,

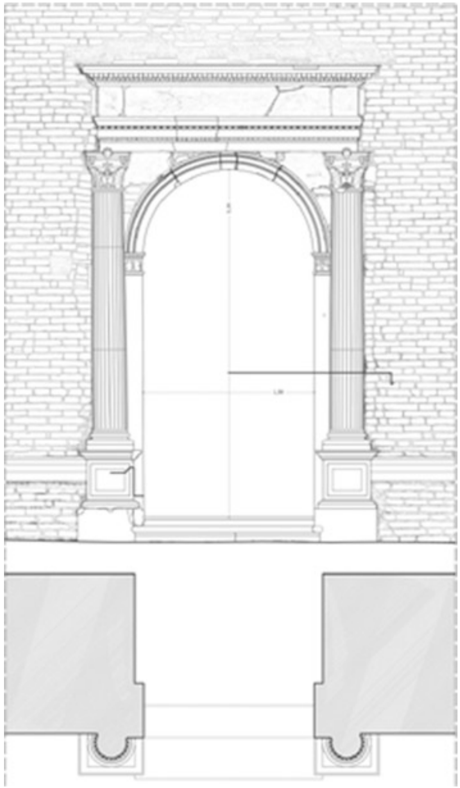


Fig. 8 Detail of the entrance portal

that allowed to suppose that the construction has taken place in a single step, in accord with the regular horizontal arrangement of scaffolding holes on the right side of the Church.

This is also evident in the architectural details, on a smaller scale, such as the curvilinear tympanum window on the left side of the façade, which has carried out a characterization of mouldings, bricks and joints, quoting, in addition to the main dimensions, a series of fi complete brick joints, which defi an important metric form (modulo) useful to read the entire elevation.

Another study is the graphic representation in scale 1:10 main entry portal, both in architectural, geometric characterizations, namely full, a sort of “reconstruction” of the main geometric lines that make up the architectural order (Figs. 8 and 9).

An attentive reading of the traditional drawings and the “new drawings”, he contributed to reading the toothing portal and window exhibits brick which it is part of the original building technique.

Fig. 9 Detail of the entrance portal using the photoplan resolution

4 Conclusions

Modernity has provided the drawing new modes of representation through digital platforms and new tools with which you can set up processing for the purpose of knowledge. Traditional designs, drawings, but also “new drawings” may be used in order to obtain useful information to knowledge of reality.

Today the quality and quantity of digital data being both can be returned or interpreted or queried directly on Media Digital tools, this makes the graphic traditional restitutions (analog) inconsistent, especially when the drawing goes from a critical character to an high level of detail.

This should make us reflect on the fact that each graphic representation is a critical interpretation and that this gives the real added value of a graphic; at the same time precise, because of the amount of data you can acquire from reality, you need to give dignity to “new drawing” to those taken directly from instrumental data processing, so they become themselves a basis on which to conduct studies and interpretations by experts.

This new type of descriptive and comprehensive representation is compared to the many questions from several scholars, as well as being uncritical and objective, as there is the passage the discretization (if not instrumental, pixel-real point) (Fig. 7).

The integration of the different technologies used in surveying work as well as the integration of instruments of returning information, highlights once again the experimental and investigative potential criticism that can be pursued this approach. An architectural building as the Church of San Bernardino is an expression of a comprehensive and lasting human experience and as such is brimming with countless characters ranging including, acquired and interpreted to meet the objectives that an architectural survey aims. Each technology applied to surveying work, describes and represents a particular aspect of well observed, but only through the integration of the information acquired and their critical elaboration of a characteristical nature, you can achieve a deep and intimate knowledge of the essence of the work. Regarding the latter aspect, the experience of San Bernardino is proving to be a perfect test case for investigating the characters, resulting in a building of great historical importance, by means of the synergy between the various interdisciplinary skills such as drawing, history and restoration.

From what emerged here it is considered that, in the same way that is now fully accepted the procedure through integration of hardware in the acquisition phase, it is appropriate to consider returning aimed at knowledge, using all the tools that technology offers us, with the only goal that the same return.

Taking as a parameter the scale of drawing, experience has confirmed as for architectural scales (1:100–1:50) design according to traditional models, though taken on a much more articulate, remains today the only real tool critical knowledge of an artifact and at the same time able to return a full and comprehensive information.

Scaling down, putting the issue of architectural detail (1:20–1:10–1:5) and particularly for some specific processed (especially elevations), experience has shown that the communication of qualitative and descriptive of the artifact, would be best resolved by direct reading digital data obtained from digital equipment.

Avoiding to stigmatise the approach opposite to using elaborations of uncritical type, which do not take account of their capital gains in knowledge of an artifact, looks mature time to give a name to these processes derived from the use of digital tools, which are uncritical precisely, but absolutely crucial in delivering some information derived from reality.

From the experiments conducted in Urbino we deduced that the return to the straditional drawing by digital data and from point clouds and topography are holding up an overall scale of 1:50; However this traditional restitution, though taken from digital data, is undoubtedly the most reliable and correct other interpretative processes carried out without the aid of massive acquisitions (direct survey by trilateration or data from total station) for the amount of data.

Above a certain scale of questioning these refunds are no longer useful as such, as they are not able to return information needed to deepen. At this level the critical reading directly executed on the photographic image resolution that can support a scale of detail and a very high magnification factor (Fig. 10).

All the efforts made by scholars on the definition of a manual of graphic treatment of surfaces, implementing technologies or different forms of degradation or characterizations today don’t seem to make more sense because they require an

Fig. 10 Comparison of imaging techniques

effort of huge processing, tainted by a large dose of subjectivity, that the "new drawing", the new digital representation, is capable of overcoming. Which can be critical processing to be performed on this data remains yet to be discovered and experimented: is this new critical stage that the Drawing with its subjective intake can actually offer a new surplus value in a proper relationship with current technology to a knowledge that is getting deeper and more thorough.

Notes

1. The Convention as mentioned also included the analysis of materials aimed at supporting the Superintendent about the ongoing restoration.
2. For the topography, has been used a Leica Total Station TCR 1201.
3. In this operation has been maintained an error between the position of the points/target in the space of 3 mm, a value considered compatible with the overall average error of the entire survey process.
4. 3D laser scanner Leica ScanStation C10.
5. On the panoramic images and for the picture straightening: (Baglioni et al. 2013; Carpiceci 2012, 2013; Clini 2011; De Luca 2011; Inglese et al. 2006; Inglese 2011, 2012; Paris 2014; Remondino, El-Hakim 2006; Remondino 2011).
6. Full frame Digital Camera Nikon D800 (32 Megapixel sensor) with lens Nikon AF 200 mm f/4D ED IF Micro, mounted on a motorized panoramic head

Gigapan Epic Pro. Thanks to Professor Riccardo Migliari for offering the above instruments.

7. The topography has been used for the correct positioning of the arrangement of the garden plans resulting from high-resolution photographs. The topographic points, taken on some specific plans materialize reference, in fact, the attitude of those plans, those issues, identified in the gigapictures, materialize properly straightened the plane on the photograph.
8. The elevations have been divided in a composition of shots: The northern side is represented by a Gigapixels composed of 96 shots, the West elevation to 132 photographs, the East elevation to 117 photographs.

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Videography, Photogrammetry and Networks. A Path to Explore—and Get Lost in?

Juan José Fernández Martín, Jesús San José Alonso and Jorge García Fernández

Abstract The photogrammetry has stood out for decades as a field of research in the documentation of heritage. In the last five years, while the current level of projects in our country has fallen far below where it used to be, other opportunities related to graphic expression have by necessity become considerably more numerous in the meantime. These opportunities related to photogrammetry and graphic expression range from interpretation, dissemination and outreach regarding heritage to the development of virtual, augmented or personalized reality systems. Having the *Videography*, *Photogrammetry* and *(Social) Networks* as main tools for documenting, describing and communicating the built environment, the hereby submitted manuscript describes the author's experiences in three different areas: teaching architectural drawing; teaching advanced architectural representation; and research in photogrammetry. Finally, this paper summarize the analysis and final consideration, related to the uses of the proposed collaborative tools for both research and teaching, and the interaction with undergraduate and graduate students.

Keywords Teaching · Photogrammetry · Social networks

1 Introduction

We have a moral obligation to explore new developmental paths for our disciplines. Photogrammetry has stood out for decades as a field of research in the documentation of heritage. The job opportunities it has offered to students have largely

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involved the preparation of proposals for architectural projects. While the current level of projects in our country has fallen far below where it used to be, other opportunities related to graphic expression have by necessity become considerably more numerous in the meantime.

These opportunities related to photogrammetry and graphic expression range from interpretation, dissemination and outreach regarding heritage to the development of virtual, augmented or personalized reality systems. To these we can add the emergence of collaborative—or social—networks that offer many possibilities; these include "creating things with a group of strangers" or forming interest groups with common purposes. The third factor we wish to include in this cocktail is the "video" as an excellent vehicle for the narration of stories. When we incorporate drawings with movement, 3D models, graphics etc. to a video, we would describe this action as making "animated drawings" within a wider context. Such videos are known as videographies.

In this paper, we wish to describe our experiences in three different settings: teaching architectural drawing, teaching advanced architectural representation, and research in photogrammetry.

In our experience, combining collaborative networks with videos and virtual models has yielded results beyond our initial expectations. Social networks have allowed us to extend our reach to include other interested individuals—outsiders who have been encouraged by our projects. The development of models for supporting content or as a basis for ideas—in other words, going beyond shape, texture and color, has necessitated the search for more appropriate systems than those we employ today. Video production has made a much larger and more rapid dissemination possible than any other medium, with the exception of prestigious journals (Fig. 1).

2 Las Videografías Videographies

When we began our architectural studies, the Rotring Rapidograph had completely displaced the drawing pen. This dynamic, which is called evolution, has always existed. Certain tools, created as improvements to the existing ones, in turn die out if they do not adapt. In other words, pen and ink drawing has not vanished; on the contrary, it is enjoying a renewed prominence now that it is only used by its most enthusiastic admirers.

In spite of allegations to the contrary, architectural graphic expression is an expanding—not shrinking—field. Canson DIN-A1 paper has not disappeared. The primary difference is that it has not been the "king of drawing" for a very long time, since it now must share the stage with other media.

Video is a "tool" formed by a sequence of "drawings", images that are seen and linked over time. Its ability to accommodate other languages is an added value.

Fig. 1 Combination of systems to perform the tasks of documenting and disseminating cultural heritage sites

An architectural drawing is much richer in meaning when it is coordinated with other drawings. The floor plan is the darling of both the cross section and the elevation, and the cross section is the parent of the constructive details.

This combination of related "drawings" has comprised what we call the "plan", and the combination of plans is a "project". This connection or documentary sequence is what builds the architectural project. In the case of video, the relation is established over time and reinforced by a sound track.

The first question that all of us must surely ask is this: if we only have time and resources for drawing, are we going to devote energy to a video? The answer requires viewing the video as an effective and energy-efficient manipulation of drawings to endow the "representation" with new possibilities. We are referring to the fact that "video-graphies" do not involve skills of cinematic directing or camera operation; they only contain a pinch of montage, a spoonful of screenwriting, and a cupful of drawings (Fig. 2).

Fig. 2 Video produced by first-year students describing an architectural survey that combines sketching, photography and 3D models

3 Photogrammetry

The new digital photogrammetry in use today makes the creation of complex 3D models possible based on a series of photos taken with any camera. Our first-year students already have the tools they need to do this. Can—and should—our highly educational and productive exercise of manual surveying involve learning surveying techniques that we previously labeled "scientific"?

Although space limitations of this article preclude discussion of the elements of quality and precision (the goodness measures) inherent in these systems, it is enough to say that if the operational goals of each survey are clearly laid out, our students have access to the systems and methods with which to achieve them. The teaching and learning objectives and the new skills to be acquired all fully deserve to be included among the basics of "architectural graphic expression".

The current availability of free processing software, either online or through school licensing agreements, leaves us no excuse to claim that there is no place for this graphic surveying system in our teaching.

It is true that our schools already offer elective courses that teach advanced features of photogrammetry. Such courses require the utilization of conventional resources, specify camera characteristics, define the use of each software program and feature costly equipment like scanners and UAVs. In other words, these are "expensive" courses from a teaching standpoint, although they become very cost-effective if they include research collaboration—that is to say, if the appreciable research teams and technical resources present in our schools play a part in the instruction (Fig. 3).

Fig. 3 3D model created solely by photographs and shared on social networks. Examples created by first-year students

4 Networks

Our field has many examples of the social networks being used for instructional purposes: graphic expression apps,[1] Facebook pages, Pinterest pinboards, blogs, etc. While they may not be widely publicized or may not have been sufficiently tested and evaluated, it is certain that the use of social networks for instruction is a resource that deserves our systematic consideration (Fontal Merillas 2004).

At the outset, the factors that need to be considered can be summed up in two short sentences: "It's all there" and "So are they". This means that the resources are already available for us to employ and that we have students who are motivated and ready for us to do this.

4.1 What Is a Social Network?

The simplest definition is that it is a group of individuals interrelated by some common element. These individuals share information that they have discovered

[1]An example of this is the "Expresión Gráfica 4.0" app.

and that they modify, or rather that they elaborate, and this information can be critiqued, manipulated, transformed and reutilized by other individuals within the network. This suggests, or should suggest, a personal reflection that can then be shared.

At a basic level, the best-known examples of this phenomenon are trivial, and they have been greatly extended to the point of forming biases in us. It is why we cannot escape thinking about the social network, of cousins and in-laws sharing wedding photos and telling us how good we look. But it requires little imagination to see classmates displaying their drawings—their “assignments”—and offering feedback on good and bad points in order to bring about instant improvement.

What is truly significant is that these relations are indeed a network (everyone with everyone), not a fan (everyone with one, one with everyone). This is the most important change we will observe if we use networked relations in our teaching: our students will learn from, and will teach, other students.

5 Search

Is it “all there”? For a number of years, bibliography has been complemented by webography. Even the most important books in our library are scanned and shared on the network. Some are illegally shared, of course—for example, if we enter “el croquis” into eMule (which we do not recommend), we can “improperly” download several dozen issues of the architectural publication by that name. As students, when we bought any magazine, we loaned it to our friends. Now the purchase is digital and the loan takes the form of archiving the file. In other words: in the area of information sharing, the network traces a fine line between what is correct and what is not (García Fernández 2014). We do not intend to take up this discussion, but it is categorically true that high-quality graphic information can be found, shared and enriched on the network.

The subject of filtering is more complex, since our libraries do not shelve bad journals alongside the good ones, meaning that a student who visits the library will only—with certain exceptions—find information that is good from our point of view. Unfiltered web results, however, list houses of the famous ahead of other houses.

Thus, if we tell first-year students to search for single-family homes, we run the risk that they will find bad and good examples and that they will not be able to discern the difference. If, however, we tell them to filter their search to single-family homes designed by Pritzker prize-winning architects or appearing in EL CROQUIS, our level of quality assurance rises exponentially.

We are then able to state that the ability to search for information should be included in our disciplines among the necessary competencies, and we are not referring to the search parameters or terms.

A humorous and minor example related to knowing how to search are the various computer-related problems that our students refer to us. I do not respond to them anymore since, among other reasons, I rarely know the answer; now I simply enter their question directly into a Google search, and in nearly every instance I find a video that addresses the question (my children use this method even to replace a bicycle pedal).

At other times, it is necessary to refine the search in order to find what you are actually seeking; in such cases, knowing how to use search terms and utilizing different browsers (not everything is on Google) is sufficient.

6 Share

Until last year, I lectured my students on sketch drawing. From their seats, they followed a reasonably fluent discussion illustrated by a series of properly selected sketch images. Through clarity, emphasis and passion, the professor managed to convey this concept to the audience. A year ago, however, I asked them, “What is a sketch?” and I told them that we were going to answer the question as a group. To do this, we created a Moodle-based wiki where students respectively uploaded three sketches from library journals—in other words, sketches not found on the internet but located, photographed and uploaded to the wiki by each student. They were also required to comment on these drawings and, of course, list references properly. Obviously, each successive student, when uploading the sketches, had to review those already on the wiki in order to make sure that there was no repetition; in addition, all students could comment on them.

We first had to provide a definition of a sketch. Then, after the tenth contribution, we asked the students to upload different types of sketches according to different characteristics.

To my way of thinking, the result was far more satisfactory than in a traditional class. For most students, the required participation stimulated voluntary contributions of undeniable interest (Fig. 4).

7 Contribute

Searching and sharing are fine, but the next step is better. This involves contributing—that is, developing and sharing one’s own personal content. The examples in our case are quite clear: students who complete their tasks knowing that they will be seen by the group as a whole take greater responsibility for them than when the task is shared privately only between student and professor—or, put another way, it is no longer enough to turn in just anything in order to meet a deadline.

In addition, when students develop a critical sense through seeing the work of their classmates, they unconsciously enrich the contributions that they make subsequently. We can state that when personal tasks are shared (contributed, in our terms), the result improves.

Fig. 4 The “sketch wiki”. Collaborative wiki by first-year students

We usually carry out this exercise traditionally, using what we call “examples from other courses”—that is, we assign a specific exercise and provide similar solutions that proved to be satisfactory in previous courses and that correspond to other comparable examples. In our proposal to use networks for instructional purposes, however, the examples to be compared come from the same exercise and are carried out simultaneously.

8 Interact

We have seen how networks facilitate searching, sharing and contributing. The next level—and for us the most relevant—involves the relationship that develops among the participants. This occurs at different levels: from direct feedback—I comment on what others have noted, and in turn I respond to their comments until a new element is produced—, or else an indirect influence caused by admiration/envy. For example, everyone in the group has uploaded their contributions and it is time for me to improve the discussion. This process currently occurs in instruction when we provide public comment on the presentation boards, where there is normally a first stage in which the professor praises the good and criticizes the bad, after which the students give their opinions. However, the reverse process can also occur in which, without prior commentary, the rest of the class is asked, “What do you think?” If the group has the necessary level of education, the process is doubly enriched since it enables everyone to reflect and offer comment, and it places the critique at the level of the student. In other words, it creates a triple level of reflection involving student, class and professor.

Fig. 5 Panoramic view of Valladolid. Developed by "Advanced Architectural Representation I" students

An example of this interaction occurred when we carried out an exercise in the course "Advanced Architectural Representation I". The task was to develop a panorama and upload it to a GigaPan page. As the students took note of their classmates' work, and especially because of everyone's comments, the result or process (the same result in another way) gradually improved (Fig. 5).

To conclude this discussion on networks, and in advance of our concluding thoughts, it is important to ask: What is the role of the professor? As just another participant? As the coordinator? As a catalyst and provocateur? The answer is complicated, since we first have to consider two factors:

- What degree of influence do our instructors have over these resources? We have to point out that in this paper we are not now speaking of virtual instruction (Moodle, Moocs, etc.), which would have to be discussed in another article, but of the possibility of incorporating these resources positively and efficiently with a measurable impact on the traditional course.
- What type of network are we utilizing? Specific "resources" offer diverse, though similar, methodologies with different approaches. The classroom bulletin board is our first network. Pinterest provides us an initial stage for sharing documents. Instagram allows us to comment on more individual and personal contributions. Twitter has the power of its immediacy and its text reduction. Facebook is fluid, etc., and all of these also have their specific problems. Therefore, it is enough to say that we are speaking not of a specific network but of the concept of one: "the concept is what matters".

9 Thoughts and Conclusions

After analyzing our experience, we believe that extending traditional graphic resources to include video as a mechanism of graphic representation has added value to our work.

Fig. 6 360° panoramic view. Created by "Advanced Architectural Representation I" students

We understand that video in our environment should be largely graphic. Even so, just as graphic design can influence the development of our architectural plans, turning them into visual poems, malleable compositions or works of art, other resources may be incorporated to create new representational forms. We are referring to the time we dedicate to the visualization of each drawing, the movement we assign to it, and even to the sound track we are able to add.

Our drawings have texts, legends, and can now even have a voice. Beyond that, they can have subtitles or even different voices in different languages, with a selection of subtitles. Our drawings can have movement, voice, life …

The second reflection, in brief, refers to the fact that the new surveying technologies already have a place in the classroom. They are not limited to research, do not require costly equipment and only call for a change of attitude among the faculty in order to increase the skills of our students.

The final thought, which we have shaped into a message, is to stress that the instructional use of social networks as we have defined them clearly adds value to our activities.

For over 25 years (in other words, since the last century) we have promoted the use of computers in drawing, and even today there are some among us who continue to debate this. Today—and this is not a new topic—we bring to the table the use of video, photogrammetry and social networks as tools of graphic representation. Now we know, however, that although we enter retirement without having reached conclusive agreement on these concepts, it is of great value to debate them.

It is a fact that we are still behind what now is "stateof-art", because if we were marching in front, we would be the vanguard of the vanguard (Fig. 6).

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Using BIM and GIS to Research and Teach Architecture

Francisco Pinto Puerto, Roque Angulo Fornos, Manuel Castellano Román, José Antonio Alba Dorado and Patricia Ferreira Lopes

Abstract This paper describes the use of BIM and GIS in our research of architectural heritage and the experience gained from their implementation from Year 1 to Year 5 in the subjects "Drawing and Machine" and "Drawing 3, Graphical Analysis" taught in the Department of Architectural Graphical Expression of the Seville School of Architecture during the academic years 2014/2015 and 2015/2016. We propose a transition towards a teaching model that integrates analogue and digital with a gradual and coherent approach based on an understanding of architecture itself as a complex system made up of various elements and attributes, both visual and alphanumeric, which allow the "graphical" to transcend the visual and incorporate different types of information.

Keywords Building information modelling · Geographic information systems · Research and teaching at the school of architecture

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1 Introduction

In the late 1960s, the exhibition entitled *Cybernetic Serendipity* (Reichardt 1968) at London's Institute of Contemporary Art launched the debate on the use of computers and digital tools in the creative processes of diverse fields ranging from literature to the graphic arts. Rather than achieve a specific aim, the *Cybernetic Serendipity* artists set out to experiment with the different ways of using machines, undertaking a series of activities that straddled both science and art. The creative process therefore generated a new dynamic in the modes of production, visualisation and interaction, not only because of the media used but also the new agents involved. Since then, and especially since the late twentieth century, the frenetic evolution and refinement of technological advances has made digitisation such an important part of our reality that we now talk about a "digital culture".

The debate about analogue and digital, which in the field of architectural graphical expression has been raging since the year 2000, has evolved from a certain rejection of the "graphical machine" to processes designed to integrate drawing strategies and digital media. In recent years, this debate has been coupled with major changes in the practice of architecture, where the "Albertian paradigm" of the "author-architect" has begun to flounder, giving way to a new idea of the architectural project in which "the vertical integration of computer-aided design and manufacturing is creating new forms of digital craftsmanship, blurring the Albertian distinction between designer and producer". (Carpo 2003, 23) Meanwhile, the potential that digital media offer for working in collaborative environments is facilitating the architect's participation in multi-disciplinary teams, challenging the notion of authorship that prevailed in the modern age. (Carpo 2003, 112) The compensation for this foreseeable loss is a profound renewal of architectural practice, which has broadened the debate on its complexity to encompass much more than its formal condition. Nowadays, that debate embraces the interaction of multiple situations and conditions which range from determining its physical and material reality to managing its sustainability and economic and social responsibility. In short, digital media are not only fuelling the demands for the architectural renderings that have become so common in our insatiable visual culture, but are radically transforming all the processes related to the conception, research, production and management of architecture. (Catalá 2005, 41; Pinto 2010)

The aim of this paper is to demonstrate how all of these issues are being incorporated into our research and teaching. In the field of research, they enable us to explore the potential for integrating the multiple disciplines that are involved in the guardianship of architectural heritage: identification, including mapping and analysis, research, protection, conservation, dissemination and management. In the field of education, they enable us to plan and adapt research and professional experience to the teaching and learning contemplated in the new syllabuses, thus meeting the demand for more transversal training that integrates the various disciplines involved. The integration of traditional drawing—which we call analogue —as the source on which the digital interfaces are built, and digital drawing, observed and practised in a critical, thoughtful manner, provides a means for addressing both the need for innovation in research and the actual aims of the new syllabuses. Within this set of new resources, Building Information Modelling (BIM) and Geographical Information Systems (GIS) encompass the various scales of matter and space, offering powerful tools for the analysis, design, production and management of architecture.

2 In the Field of Research

Most of the authors of this paper are investigating the same themes as the research group HUM799 (http://grupo.us.es/ecphum799), focused on heritage knowledge strategies. The project we are currently undertaking is based on the hypothesis that it is possible and indeed necessary to use the new technologies to combine the scattered and disjointed data from the different fields of knowledge which, each in its own way, impact on the architectural models of our historical and cultural heritage that stem from numerous increasingly specialised disciplines (archivism, archaeological, architectural, visual, analytical, economic, etc.). This convergence (basically, inter-related or inter-connected heterogeneous information) requires the design of a specific IT tool, which must be complete and flexible enough to significantly optimise decisions regarding this heritage (conservation, maintenance, restoration, renovation, management and dissemination). We are therefore exploring ways of modelling architectural heritage, understanding this model as a mental construct that entails more than reproducing its present form or formulating hypotheses about the possible state of earlier forms. Indeed, we view this model as a vehicle for thinking about these forms and integrating them into the aforementioned disciplines (Pinto and Guerrero 2013, 137). The use of BIM in this field, even if specifically focused on new-build architecture, is proving to be extremely useful for addressing the challenges posed. One reason for this is its capacity to manage vast quantities of information, visualise relationships, and investigate a crucial issue in the heritage field: time, a contemporary value that makes it much more difficult to understand this type of architecture (Fig. 1).

The advances in this respect have led to complex models which in addition to the usual material characteristics and the hierarchisation of the building processes now include the sequencing of the various states, alteration and destruction processes, and the classification of spaces by defining their precursory elements, be these formal or pathological. Our project began by modelling and managing the information associated with an archaeological ruin, the Hylas House at the archaeological site of Itálica, (Angulo 2012) which emerged following the architectural analysis and diagnosis of the remains prior to the definition of a master plan. As the next stage in our project, we used digital models and databases to plan and develop the case for the legal protection of the church of San Pedro in Arcos de la Frontera, Cádiz province Castellano (2013). More recently, we have modelled the chapel of La Virgen de Antigua in Seville Cathedral, which offers an example of Late Gothic

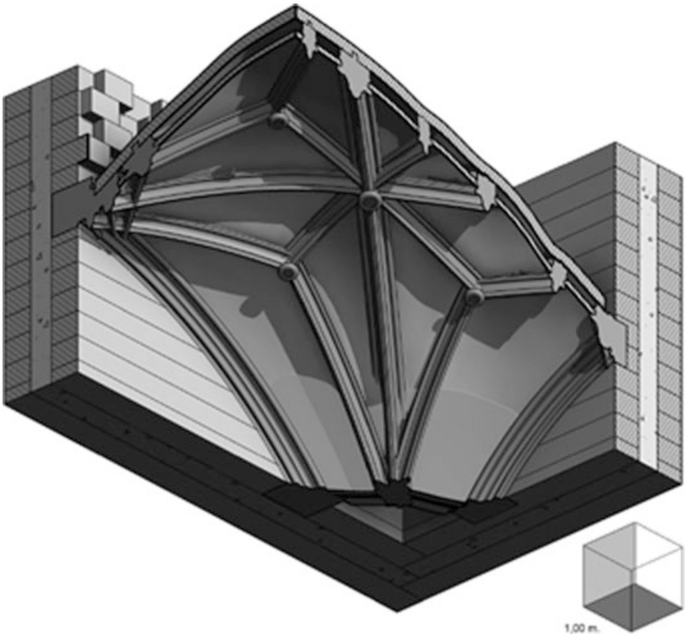

Fig. 1 Chapel of La Virgen de Antigua in Seville Cathedral. BIM Model. Author Roque Angulo Fornos

architecture subjected to a complex sequence of transformations through the ages and whose interpretation though the digital model is shedding crucial light on how it reached its current state (Angulo 2015; Pinto and Angulo 2015). In all of these cases we used BIM, adapting the models as necessary to incorporate heritage considerations. To build the models we either used existing plans or digital photogrammetry and laser scanning, according to the aims of the project in question. Since we had obtained our data from different types of records and analyses, we systematised all potential input data for the BIM models, classifying the modelled objects according to numerous properties and attributes, which can be edited, in order to visualise relationships that had previously gone unnoticed. One of the principal advantages of BIM models is that they evolve with the actual analysis of the heritage object in question: in other words, from the moment its merits are recognised and protected under the aegis of some form of legal regulation and it is included in a catalogue or inventory of protected assets, to its profound study, restoration or formulation of plans for its future conservation. This evolution is in line with the LOD (Level of Detail) specifications that have become a standard component of BIM systems applied to new buildings, not only facilitating the ongoing amortisation of the time and financial investment in creating them but guaranteeing their efficiency in accordance with the aforementioned principles of combining scattered and disjointed information from different fields of study (Figs. 2 and 3).

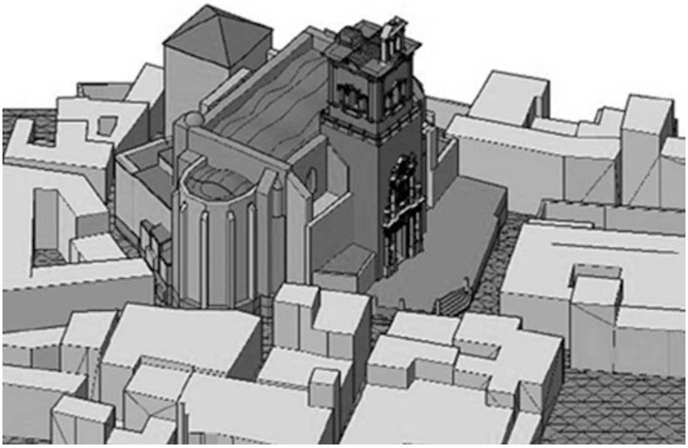

Fig. 2 Church of San Pedro in Arcos de la Frontera (Cádiz) Heritage Information Model. Author Manuel Castellano Román

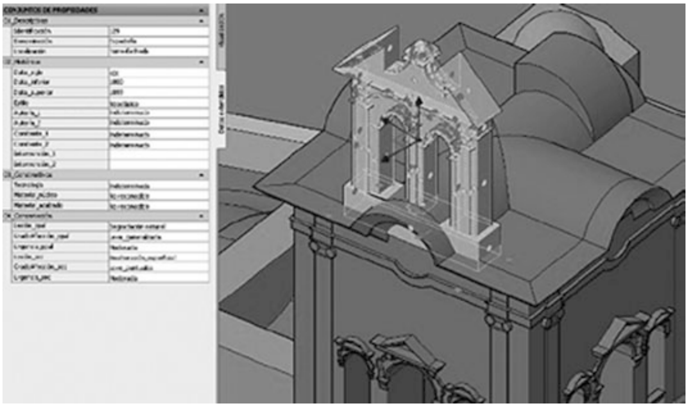

Fig. 3 Church of San Pedro in Arcos de la Frontera (Cádiz) information about the bulrush on the tower in the heritage information model. Author Manuel Castellano Román

However, the scale of the problem is larger than the building itself because many of the explanations for its forms and the vicissitudes it has undergone are rooted in the territorial aspect and its relationship with contemporary works, often scattered across a vast region or the whole country. In order to address this new framework, we have used Geographic Information Systems (GIS). One of the first issues to consider in relation to GIS is that this technology has traditionally been associated with geography and the use of a set of techniques and methods in the various aspects of this discipline, ultimately transforming this field of study. In the field of architecture, GIS was initially used for urban development, especially as regards transport and mobility, before being extended to urban planning and management. Today, following major advances and improvements in digital tools, coupled with their enormous data processing and analysis capacity, we use GIS in different ways to understand architecture in all of its complexity, connecting it to the cultural, social and historical aspects of a spatial environment. Our experience has enabled us to confirm the usefulness and vast potential of GIS for analysing and managing heritage. Since heritage demands a multi-disciplinary yet coherent vision, GIS offered us a "point of union" for relating information in different formats (images, plans, maps, tables, texts, etc.) and of a diverse nature (historical, economic, architectural, geological, anthropological, etc.). As part of the aforementioned research project currently under way, we are trying to create a digital model of information on the structural organisation of Western Andalusia in the post-Reconquest, Late Gothic context when the foundations for the modern territory were laid, since these largely explain its structure today. Our ultimate aim is to examine the spatio-temporal networks generated by the building enterprises (civic and religious buildings, infrastructure and roads), with a special focus on the professionals and artists involved (Ferreira and Pinto 2015). Accordingly, our premise is the digitisation and processing of graphical documents and alphanumeric data which, processed in the GIS environment, can be cross-referenced and situated in space and time to generate visualisations and analyses, thus creating new images and interpretations that not only provide answers but also pose new questions about the built object.

By inter-relating both systems, BIM and GIS, we can move freely between seemingly very distant scales whose common mission is the construction of info-graphics (inter-connected alphanumeric and graphical data) to obtain and actively manage knowledge, preserve values and facilitate the conservation of heritage (Fig. 4).

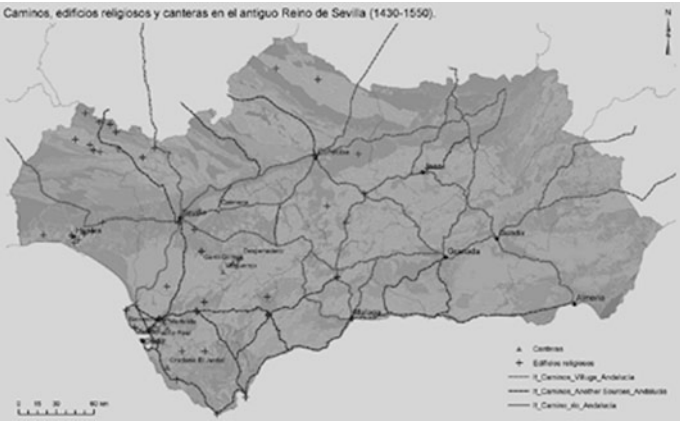

Fig. 4 Digital model of information on the structural organisation of Western Andalusia in the post-reconquest, Late Gothic context. Author Patricia Ferreira Lopes

3 In the Field of Education

With regard to the teaching and learning process of architectural drawing, we have gradually incorporated the contents contemplated in the 2010–2012 syllabus and the common subject programmes taught in the Department of Architectural Graphical Expression at Seville University. However, we do not believe that architectural drawing can be taught in isolation, without reference to the nature of the graphical media used in the teaching process. In other words, the teaching of digital drawing cannot be seen as a mere adaptation of analogue drawing processes to the digital graphical environment, simply choosing between one or the other as a form of acquiring expertise in different techniques. Rather, we have encouraged the integration of the analogue with the digital, so the choice of the graphical tool is not determined a priori but is dependent on the purpose of the graphical constructions proposed.

In previous syllabuses, a subject like Assisted Drawing at the Seville School of Architecture took its name and established its contents exclusively on the basis of the fact that the work was conducted on a computer. It was an urgent response to the need to address the learning and critical knowledge of digital drawing tools which, in the professional realm and even the students' practice, were not contemplated in the syllabuses. At the conceptual level it did not represent a profound alteration because, in general, it was merely the transposition of the processes used in analogue drawing to the digital medium, and almost exclusively to Vector CAD. Even so, some innovations were gained from the increased graphical capabilities: 3D modelling, the dynamic manipulation of volumes and surfaces, and 2D vectors encoded as the final documentation of a graphical process conducted in 3D. In this academic context, only a handful of teaching plans incorporated parametric CAD and BIM, allowing students to experience the material nature of architecture, the potential of parametric creation and editing, and the coordination of the various encoded representations. Therefore, the representation of an architectural organism was not limited to the use of abstract graphical signs like points, lines and blobs, but required a global understanding of the organism and the recognition of each and every one of its building elements and systems.

In light of this experience, our teaching plan for the current syllabus was underpinned by the consideration that it was crucial to stop viewing the digital architectural drawing as a homogeneous set of processes and results, usually associated with digital vectors in CAD programs or, at most, with rasterised digital drawings of renderings. Today, the digital architectural drawing offers a vast repertoire of devices and programs which share a digital nature in common but can nevertheless vary dramatically in their approach to the graphical question. We therefore need to consider how appropriate they are for the various teaching plans and the academic development of students, and also to take an overall view of the role that the Department of Architectural Graphical Expression can play in this.

In this respect, there is a certain consistency between the evolution of digital architectural graphics programs and the objectives, competencies and teaching-learning processes defined for the subjects taught in this department at the Seville School of Architecture. This consistency is founded on the adaptation of each computer program to the conceptual contents of the subjects, which as a matter of principle avoids any assimilation to a specific course on a given program. Accordingly, we have defined a series of categories for the digital architectural drawing programs and introduced them in what we believe to be the most appropriate year and subject. In any case, we must remember that this is cumulative knowledge and that the use of a specific digital drawing program does not exclude the use of analogue drawing or any other digital drawing programs with which students are already familiar.

In the analytical CAD vector, the graphical objects are defined as independent geometric elements, characterised by their spatial coordinates (x, y, z) and classified with abstract codes (colour, line type, layer) whose meaning is interpreted by the user and which facilitate the logical organisation of the graphical information, visualised using cylindrical or conic projection systems. The geometric dimensions of the architectural form can be specifically addressed with these types of programs, which have the advantages of precision, accuracy without detriment to the support, and the unlimited reproduction offered by the digital environment. We therefore regard analytical CAD to be a particularly appropriate graphical tool for achieving the objectives of the subject *Drawing 1: Geometry and Perception* in the first year of the course.

That same year, as a continuation of *Drawing 1*, we teach *Drawing 2: Expression and Communication*. To address these aspects, we can extend the possibilities of the CAD programs already used since they normally include specific functions for documenting models and generating renderings to explore the visual attributes of architectural forms. This is also an appropriate point to introduce the possibilities afforded by raster image processing programs, either to increase the communicative potential of digital architectural drawings or even as a medium for creating mixed images obtained from digital photographs, digitised analogue drawings and exclusively digital drawings.

We have already described the characteristics and potential of BIM programs, as discovered by our group when they have been used in the field of architectural heritage. We regard their incorporation in the teaching of architectural drawing as particularly appropriate in Year 2, specifically in the subject *Drawing 3: Graphical Analysis*. Year 2 students have already used drawings as a means of representation and have discovered, if only through the name of the subjects, the convergence of concepts that transcend the mere geometric characterisation of architecture. In our proposal, BIM modelling complements analogue drawings, CAD vectors and the processing of raster images, increasing –though certainly not exhausting– the possibilities afforded by analysing architecture with digital graphics. The BIM methodology offers a specific graphical medium for integrating into a single model architectural dimensions such as the environmental parameters derived from its geographical location, its volumetric and spatial attributes, its technotherefore be expressed in alphanumeric tables, and which cannot be measured and require other forms of graphical expression.

The next category we establish are programs that facilitate visual programming environments for parametric design. The graphical entities of BIM programs are parametric objects, but we are referring here to parametric design as a process of computer-aided design in which the graphical entities can be defined according to open variables (parameters) and certain conditions of association between them, expressed in terms of a logical sequence of geometric-mathematical operations. Consequently, a parametric design does not produce just one solution but a range of solutions, as wide as the defined parameters allow. Although initially used to design machines, its applications for architecture are providing a constant source of formal investigation, supported by the ease of connection with rapid prototyping processes and digital manufacturing using numerical control machines. We therefore believe that it would be interesting to explore the unique contributions of these programs in certain architectural conception processes examined in the Year 3 subject *Drawing 4: Conception* (Fig. 5).

The unique teaching experience derived from the *Architecture Workshops*, where teachers of different subjects converge, reinforces the appeal of BIM programs for providing a common platform of graphical integration, without detriment to any other graphical operation or medium that may prove useful. Indeed, logical and building dimensions. It also facilitates discussion about which aspects of architecture are measurable and can this is endorsed by the results of the research experience described above.

In Year 5, the elective subject *Drawing and Machine* is proposed as a synthesis of the relationship between architecture and the digital graphical technologies (drawing with machines), and as a reflection on architecture as a built device that constitutes a complex system (drawing of machines). This synthesis requires the student to re-examine all the graphical resources used, with BIM retaining its pride

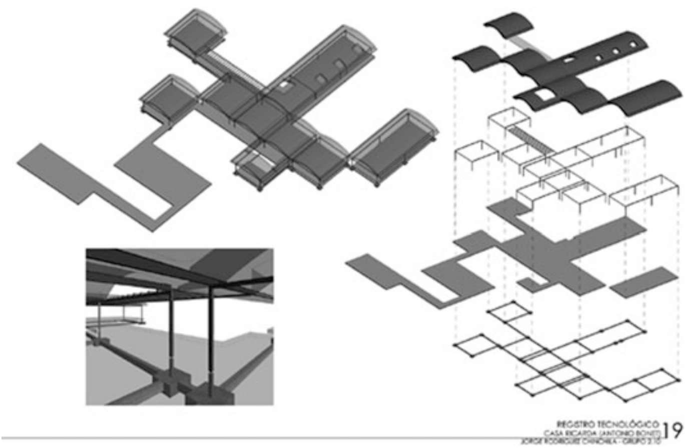

Fig. 5 Exercise in the subject drawing 3 graphical analysis, developed with BIM methodology. Student Jorge Rodríguez Chinchilla. Professor Manuel Castellano Román

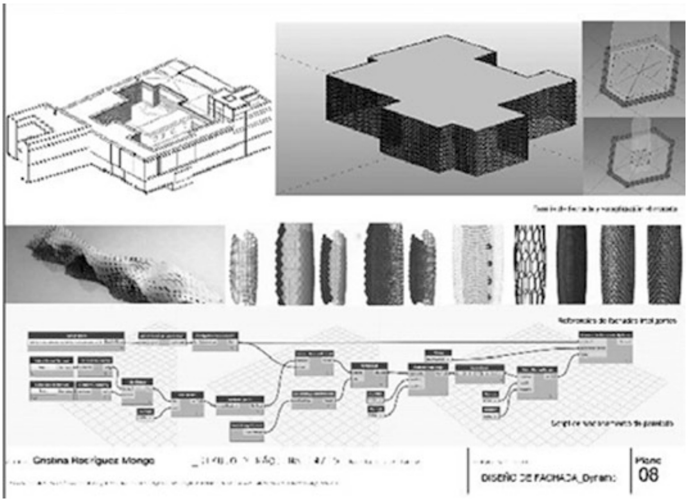

Fig. 6 Exercise in the subject *Drawing and Machine* developed with BIM methodology and parametric design software. Student Cristina Rodríguez Monge. Professors F. Pinto, R. Angulo, M. Castellano, J. A. Alba, P. Ferreira

of place, precisely because of its quality as a nexus. A new characteristic is added in this year of the course: the possibility of generating collaborative work environments and re-thinking the role of the architect in society and in the production of architecture (Fig. 6).

Finally, in *Drawing and Machine* we introduce geographical information systems. When one looks at GIS teaching in architecture schools, it is immediately evident that little work has been done on this subject, and most of it has been focused on teaching the applications of GIS for urban management. Interestingly, the courses developed examine territory in the light of recently gathered data, with alphanumeric information linked to spatial entities providing a fundamental element. The teaching experience conducted at the Seville School of Architecture is focused on developing and augmenting skills for thinking about space in a non-linear and interdisciplinary manner. The proposal consisted in demonstrating the various possibilities that GIS technology offers by examining case studies and conducting practical exercises in the classroom to enable students to create historical theme maps, adding information to their entities and comparing them with the present situation. This entailed viewing the production of territory as the result of different forces (economic, cultural, social) by juxtaposing layers from different periods, which enabled us to merge historical and current data and show students that GIS has applications not only in the field of urban management but also—possibly mainly—in the field of heritage.

4 Conclusions

The use of BIM and GIS systems in the heritage field opens up new avenues for researching and interpreting architectural heritage. In addition to providing systematisation and flexibility, their ability to process vast volumes and types of data mean that not only architects but historians, archaeologists and geographers as well can contribute information from complementary disciplinary approaches, since the BIM-GIS graphical model offers a common medium. In our case, the methodology applied to the context of Late Gothic architecture can be transferred and adapted to other heritage contexts and objects, which in the short to medium term will enable us to extend our field of study, both spatially and temporally.

In relation to the teaching experience with the two systems, the results obtained during the pedagogic intervention and their subsequent systematisation bring home to students the diversity of the records that converge within a work of architecture, and the need to integrate them rationally, maintaining a critical attitude to the mechanical requirements of the system, which must always be underpinned by theoretical reflection. The construction of the BIM model is a way of thinking about that architecture, of creating mental maps. In these maps design can interact with the value and cost of the solutions adopted in real time, which reinforces the responsibility for the decisions made. In the field of GIS, students have learned how to view territory as a dynamic space that lends itself to reflection on the infinite relationships between its elements, be these topological, spatial or alphanumeric. The use of maps, projection systems and GIS databases not only enhances students' repertoire of graphical tools but offers them a new way of thinking about and understanding architecture, from its object-based scale to its insertion in the territory.

Based on these experiences, we therefore propose a transition towards a teaching model that gradually and coherently integrates the analogue and digital across the various modules and subjects that students must complete during their degree course. This will not only enable them to understand architecture as a complex system made up of different elements and attributes, both graphical and alphanumeric, but will ensure that the "graphical" transcends the visual to incorporate heterogeneous types of information.

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“The Discourse of the One Thousand Works”: The Seduction of History and Politics of Excess

María Álvarez García, Carlos Naya Villaverde, Inmaculada Jiménez Caballero, María Villanueva Fernández, Luis Manuel Fernández Salido and Víctor Larripa Artieda

> “*The historical articulation of the past does not mean to know it “as it has truly been.” It means to seize a memory as it flashes in a moment of danger. (…)*”
> Walter Benjamin. *Angelus Novus*
> “(…) *–Moderation is a fatal thing, lady Hunstanton. Nothing succeeds like excess.*”
> Oscar Wilde. *Una mujer sin importancia*

Abstract In the 70s and 80s hot trading with architectural drawings started thanks to the role played by Schools and Institutions that, throughout publications and exhibitions, opened their treasures to the public. The postmodern cultural context for the celebration of the *Centenary of the School of Architecture of Barcelona in 1977* was particularly specific in Spain due to the period of the political transition and the crisis of the architectural school. This paper will focus on how through an

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This chapter was the Spanish title (“*El Discurso de los Mil Trabajos*”) given by Lluís Doménech in his article about the exhibition in *Arquitectura Bis* in 1977.

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ideological use of drawing the reading of history in graphic terms could be used to propose a *critical* renovation of the architectural school rooted in what has constituted the discipline as so: the disciplinary drawing.

Keywords Drawing · Exhibition · School

The "image" of the whole could be seen from the platform: thirty long tables covered by white cloths colonizing the "Great Oval Salon" of the National Palace in Montjuïc. They showed one thousand "products" of the School throughout one hundred years of existence (Figs. 1, 2, 3, 4, 5). In the same year, 1977, one hundred drawings summarized the history of architecture during the Spanish period of autarchy. This exhibition, "*Arquitectura para después de una Guerra*", was shown in Madrid and Barcelona. In 1972, the Architectural Association celebrated its 125 anniversary with an itinerant exhibition, and only three years later, in 1975, the MOMA of New York opened a show with two hundred drawings, carefully selected by Arthur Drexler, and which narrated part of the history of one of the most famous academy of architectural education: *l'École des Beaux-Arts*. After this show, it followed in America the 45 years review through the work of 45 students of the School of Architecture of Princeton University in 1977 at the IAUS: "*Princeton's Beaux-Arts and its New Academicism: From Labatut to the Program of Geddes.*" In 1981, the School of Architecture of Columbia would celebrate its centenary with another exhibition, "*The Making of an Architect, 1881–1981: Columbia University in the City of New York,*" shown at the *Columbia University Science Building* as well as at the *National Academy of Design* (Washington DC). Several exhibitions followed in Paris. Among them, organized between Paris and Athens and opened in 1982 at the *École Nationale Supérieure des Beaux-Arts,* the exhibition: "*Athens: Le voyage en Grèce des Architectes Français aux XIXe et XXe siècles"* that travelled to Athens, Houston and New York, and which followed another two previous shows in 1980, "*Le Voyage d'Italie d'Eugène Viollet-le-Duc*" and "*Pompéi. Travaux et Envois des architectes français au XIXe siècle*."

In the 70s and 80s, many institutions revised their history opening up their drawing cabinets and many publications were edited. Jean Leymarie, the then head of the French Academy in Rome, pointed at this fact when presenting the book "Drawing"[1] he referred to the new interest placed by libraries, museums and academies in periodically opening their treasures to the public, "for so many year kept only for the initiates. The exhibitions and publications about drawing multiply, coinciding with the revival of graphic activity, in order to answer to the increasing curiosity awaken by a discipline that, although confidential, is essential" (Leymarie

[1]The book was edited in 1979 in collaboration with Geneviève Monnier, curator of the drawing cabinet of the Louvre Museum, and Bernice Rose, curator at the Drawing Department of the MoMa in New York.

Fig. 1 Exhibition of the Centenary of the School of Architecture of Barcelona in the “Great Oval Salon” of the National Palace, in Montjuic, Barcelona, Spain. (1977)

Fig. 2 Exhibition of the Centenary of the School of Architecture of Barcelona in the “Great Oval Salon” of the National Palace, in Montjuic, Barcelona, Spain. (1977)

[1976] 1986 vii). Some *democratization of culture* was accomplished through the exhibition of these graphic materials. In a sense, this sort of fascination was used as a channel for approaching the public by showing “drawing” as the principal force for conceptual thinking made by artists, a continuum that could be traced throughout history to the creation of the first Academies (Petherbridge 2011; Pevsner [1940] 1982). It was in the Renaissance that by means of drawing architecture became to be understood as an “intellectual profession” instead of a craft. With Alberti, “design as profession” was invented by separating the conception of the drawing from the execution of the building. It was not more a “dirty” drawing made on site, but a “clean drawing” produced by the architect and able to contain the idea of the building.

The idea of drawing as the singular activity that characterizes the work of the architect returned through the discussion that took place within forums and symposiums. It was in the Fall of 1977, at the Forum “*Drawing It Out*” organized by the

Fig. 3 Exhibition of the Centenary of the School of Architecture of Barcelona in the "Great Oval Salon" of the National Palace, in Montjuic, Barcelona, Spain. (1977)

IAUS, William Ellies pointed out that we were entering a period when graphic representation was substituting the building itself, so "a number of galleries have begun hot trading in architectural drawings as art objects, whether or not those drawings are intended to lead to pieces of architecture. In the past year, four exhibitions have hung in the Cooper-Hewitt Museum, The Drawing Center, and the Leo Castelli gallery downtown; thus the subject of the latest *Oppositions*' Forum, *Drawing versus Idea: The Recent Exhibitions.* … The exhibitions had suggested a number of reciprocal connections between drawing and architecture, from drawing as instrument, to drawing as ultimate icon, to drawing as the architectural object itself" (Ellis 1977, 106).

This renew interest placed upon *history* as well as *drawing* shows the *radical revisionism* that had been taking place within institutions. These attitudes discovered in the approach to the project of these exhibitions reflect as well the Crisis of Modernity that was being debated during the 70's. This crisis was developed in parallel to the process of political transition in Spain and to the pedagogical crisis suffered by the Spanish University in urgent need of renovation due to the increasing students' overcrowding. As a consequence, in 1975, two critical reports about the state of Spanish Architectural Education were published. From Madrid, under the direction of Antonio Fernández Alba, "*Ideología y Enseñanza de la Arquitectura en la España Contemporánea*", and in Barcelona, Josep Muntañola Thonberg gathered "*Materiales para un análisis crítico de la enseñanza de arquitectura.*"[2]

[2]It could also be added the essay by Oriol Bohigas published in 1970, "*Las Escuelas Técnicas Superiores y la Estructura Profesional*," edited by Nova Terra within their collection of "Debate Universitario."

It was within this context, with the democracy on the horizon and as a result of the debates about architectural education that took place in the School in the academic year of 1974/75, that the project for the *Exhibition to commemorate the Centenary of the School of Barcelona* was develop. Ignasi Solá-Morales, chairman of *Composición II*, was in charge of the organization and the architects Jordi Garcés and Enric Soria were in charge of the design of the exhibition. The Centenary was seen as an opportunity to make a first revision of the history of the school, which would be taken as a first step to recover the critical approach that had characterized the School throughout the years. By *Critical School* they meant that there were "no magical forms to resolve the problem of Architectural Education, which needed not so necessary a special organisation or an education plan, but *a constant analyse action* of the conditions where the education is and the frequently proposition of strategyc plans which will decide the ways we can follow any moment" (Solá-Morales and others 1977, 339). It is in this sense that the project for the exhibition could be understood as a "critical tool," in which design attitudes, from its big dimensions, the selection of the place, or its spatial organization turn the show into a singular event not only for the School and architectural education, but for contemporary architectural culture. It was the exhibition strategy to show in a sense the contemporary architectural debate of the international critique by questioning the role of the school within the city development as well as the definition of the professional architect or the discipline itself by means of the exhibited "drawings."

The "critical mass" of the exhibition was provided by the one thousand drawings shown. Theses "products" also contributed to the "realism" and "objectivity" aspired by means of the excess of information provided by the organizers. The material did not only belong to the School of Architecture, but a lot of information proceeded from the *School of Lonja* and the *School of Master Masons,* which were the immediate predecessors of the institution. In the same way, many documents were found in the Archives of the City of Barcelona. The big dimension of the show was voluntarily decided by the organizers of the exhibition. It was due to the lack of unity provided by the materials, whose conservation has depended upon arbitrary criteria. The preserved works were not due to their quality, but for more accidental reasons such as the decision made by a professor of keeping or not a work, or the students' decision of recovering their exercises. However, this could also be accepted as a positive hypothesis, according to the organization, because the viewer would be this way provided with a material exhibited without going through any selective process.

In any case, although this *objective materials* made possible "the incursions by the most signifying of the educative forms, context of the most qualifiers courses, the system, the description forms, etc. trying to understand it from the best view from social terms, which conditioned the limits where the professional education had to find a place" (Solá-Morales and others 1977, 339), it was also displayed an "image" of the school through this material. Bernard Knox pointed it out when referring to this kind of exhibitions, specifically to that of the Beaux-Arts paintings that took place in Paris, since "usually an exhibition … is … an anthology of works carefully chosen from among those most characteristic of a famous painter. In this case there is a complete series of paintings painted by young men in the course of becoming artist …" but in this case, "we are faced with a selection of works which … we did not make but which was made for us by the 19th C board of examiners…" What we discover in it, to quote Thullier … is "the image of an *institution*" (Knox 1984, 21). An "image" provided by the extensive mosaic formed by the drawings, in which no school period prevails in order to compose a *whole* out of these *fragments*. In a sense, it was revealed a "realistic" approach by means of an "eclectic" view, a historical glance that did not aspire to make any value considerations thanks to the rationality shown by the exhibition display. This rationality contrasted the historicist space of the Great Salon. It was the will of the architects, Garcés and Soria, to shown, on the one hand, critical support to the values provided by the artistic and cultural material and, on the other, to look for "a design in which its technical equipment answered clear, exact and simple architectural laws" (Garcés, Soria 1988, 6).

The "institutional image" would be clearly described by the organization: "a sort of School like the one in Barcelona, dependent on the government, is never a place the avant-garde creation. We might almost dare to say that structurally it constitutes the opposite to those sort of cultural experiments. We have been aware of that from the very beginning. The history of rupture, of the most creative proposals, few times comes across an institution like ours. Its influence, its cultural weight, is dependent on other mechanism. Its survival, its connexion to the State apparatus, mediated through bureaucracy and certain class character, homogeneous with the whole institution of the University, placed on the school some interest, not as much for the pioneering character these institutions may achieve, but for its creator character of the cultural infrastructure by which the production of the city takes place" (Solá-Morales et al. 1977, 311). They would also state that "the School had no purpose of training professionals to cover certain jobs… its only purpose was to persist" (Solá-Morales et al. 1977, 360). This argument would be broadly criticized by the publications that followed the exhibition;[3] however, to adopt a "realistic" approach, linking the School to the creation of culture and the development of the project of the city, it constituted an ideological view framed within the contemporary critique of modernity.

This way, the exhibitions would be organized according to the *external history*[4] of the school, reminding us about the *collective character* of architecture. As Ignasi Solá-Morales pointed out, "the primacy of the urban point of view in the most general consideration of architecture and its pertinence to the dominant ideological systems are the starting point of a neither ludic nor marginal of architecture, but of a civic and political formulation of the problem of contemporary architecture. … A self-reflection process, both theoretical and civic, that leads to rethink the problem

[3]Magazines as *JANO Arquitectura*, *CAU*, *Arquitecturas Bis* or serveral articles in *La Vanguardia* commented on the celebration of the School Centenary.

[4]The content of the exhibition would be divided in three chronological stages according to the development of the city of Barcelona: "*Hacia la Nueva Barcelona*" *(1875–1917)*, "*Hacia la Mayor Barcelona*" *(1917–1953)* and "*Hacia la Gran Barcelona (1953–1976)*".

of architecture as a collective phenomena" (Solá-Morales 1980, 209). The exhibition could also be organized from the point of view of an *internal history* of the institution, "as may be, for instance, that of considering the different teaching approaches, the evolution of the teaching methodologies and their dependence on economy or government politics, the different meanings of each subjects and professors, the new dynamics of the students depending on their number, etc.;" however, the critical approach to the exhibition intended to narrate its "*history* by understanding the School as both, advance and reflection of the professional activity, tightly conditioned by the contemporary political and economical structures" (Domènech 1977, 22). It was in this sense, that it was not "the intrinsic quality of the works what we wanted to show, but the idea of architecture that allows their production" (Solá-Morales et al. 1977, 311), what is to say, the relation established by the professional and cultural ambience with the school along time.

An "eclectic" attitude was observed in the shown materials through the coexistence of many different "projects" within the exhibition. The first stage (1875–1917), included exercises as the watercolours of P. Forés for the "Dux Palace" in Venice (Fig. 6) or the "Temple of Vespesiano" (Fig. 7), it was also displayed the designs by Puig i Cadafalch for a "Monumental Bridge" (Fig. 8), that with the design of libraries, stock exchange buildings, train stations, hospitals, etc. were very common exercises at the School and a clear reflect of the growth of the city of Barcelona. The second stage (1917–1953) implied a return to the "academic classicism" and embraced designs as the "ejercicios de reválida" (*final degree projects*) as the "Natural History Institute" (Fig. 9) or one for a "Glyptotekca" (Fig. 10). Finally, in the third stage (1953–1976), it would appear housing designs or composition exercises for the subject "Analysis of Forms" together with a final stage of this period where could be seen the composition designs for Rafael Moneo's course, or the final degree projects by the contemporary school teacher such as Santiago Roqueta or Luís Clotet, or some of the designs for the course in Urbanism by Manuel Solá-Morales. Certain "eclectic" attitude would be necessary in order to approach the "critical line" of the School of Barcelona that the organizers wanted to recover. As Josep Maria Montaner had stated, criticism and eclecticism go hand in hand, as it is necessary a critical attitude for theory to exist, so it is the diversity of possibilities, since "… history needs always to be contemporary, coexisting within its definition the concept of criticism, of interpretation and the aesthetic judgment"[5] (Montaner 1999, 23). It was in this sense that the project of "historical criticism" wanted to be incorporated to the School of Barcelona, this way approaching itself to the contemporary debate of the seventies at the same time it would singularize itself

[5]He will go on saying, "in this sense it is obvious that the Latin culture (in the Mediterranean, South America, including Cataluña) has predominated authors devoted to both, criticism and history, whereas within Central European and northern cultures (specially in Germany and England, including Madrid) the work of criticism has been dissociated from history" (Montaner 1999, 23) Criticism, following Montaner, will appear towards the end of the 18thC and it will continue in the 19thC "due to the diversity of interpretations and the pluralism that followed the crisis of the unitary world proposed by the classic tradition" (Montaner 1999, 12).

Fig. 4 Exhibition of the Centenary of the School of Architecture of Barcelona in the "Great Oval Salon" of the National Palace, in Montjuic, Barcelona, Spain. (1977)

Fig. 5 Exhibition of the Centenary of the School of Architecture of Barcelona in the "Great Oval Salon" of the National Palace, in Montjuic, Barcelona, Spain. (1977)

Fig. 6 Watercolor of P. Forés for the "Dux Palace" in Venice (exercise between 1875-1917)

from the Madrid centrality within the new political Spanish context of the "State of Autonomies" and the new pedagogical reform of 1970.

In the same way that the drawings organized according to different "tendencies" allowed to discover what they had in common, it also allowed the discovery of the "singular," always within its historical *context*. Thanks to the rationality of the disposition of the tables, a grid colonizing the space was constructed, so knowledge was not only classified, but *positioned* within the coordinates formed by the grid.[6] It was precisely in this way that the search for the *original* would become the search for *originality* through the strategy of *excess*, i.e., throughout the quest of that which *exceeds* the common root, the essence, of things, which was understood as the consequence of its context and a symptom of identity.[7] The placement of the wax

[6]The grid, as Rosalind Krauss has defined it, announces the will to silence and its hostility towards discourse, "they are spatial entities, visual structure that explicitly reject any kind of narrative or sequential reading." See: KRAUSS, Rosalind. *La Originalidad de la Vanguardia y Otros Mitos Modernos*. MADRID: Alianza Editorial, 1996, p. 6.

[7]Toni Negri explained in his book *Arte y Multitud. Ocho Cartas* (1988) the change of paradigm between the place where beauty lies. For modernity it is within the "essence" of things, but with the postmodernity beauty lies within the "excess," beauty is search in the "excess of being." This consideration is believed to be important because the approximation to the study of the graphic

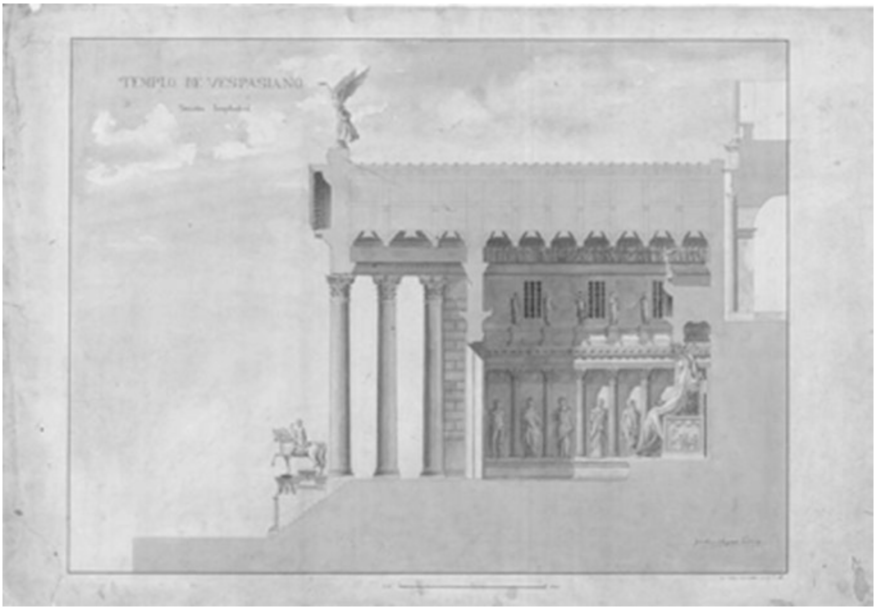

Fig. 7 Watercolor of P. Forés for the "Temple of Vespesiano" (exercise between 1875-1917)

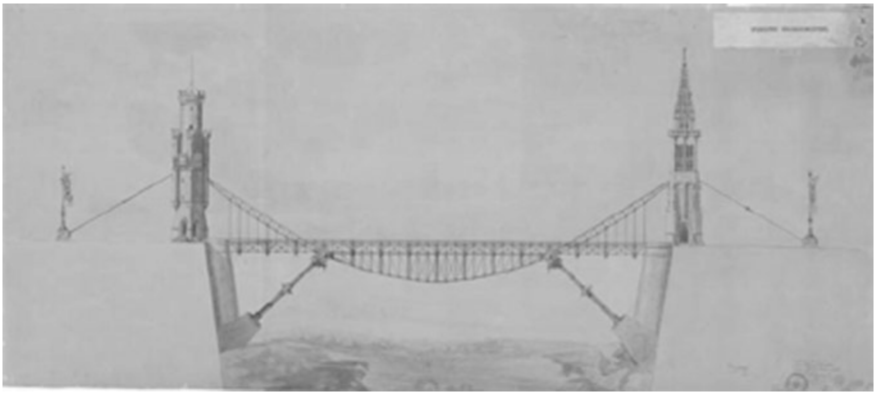

Fig. 8 Design by Puig I Cadafalch for a "Monumental Bridge" (exercise between 1875-1917)

(Footnote 7 continued)

material would change, in the sense that signs of identity would be looked for in this "excess," that would now become valuable. Also aspects as colour, density, etc. would be valued in a drawing, whereas the drawing of the modern genious aspired to enclose beauty within the essence of the line.

Fig. 9 "Natural History Institute" final degree project (between 1917-1953)

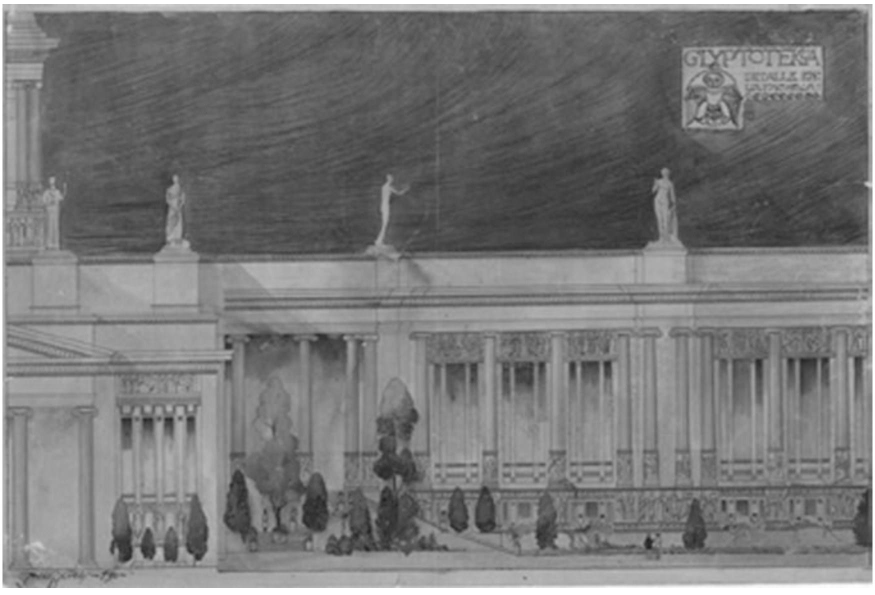

Fig. 10 "Glyptotekca" final degree project (between 1917-1953)

figure of Gaudí, seated in front of his drawings emerging from the grid, could be so understood. The master *was not an isolated genius* or "an outburst of human nature, but the result, certainly singular and with a major superior capacity from that of his time, of the approaches of *certain sectors* within his contemporary society" (Solá-Morales 1980, 34). As Solá-Morales has explained, the context of the work of Antoni Gaudí was marked, at the end of the 19th C, by the use of drained eclectic formulas, both in the use of the historical language as in the compositional methods, so "the master's answer within this situation *is truly radical due to its critical approach rather than its innovation*" (Solá-Morales 1980, 32). Then, it could be said that the almost surreal presence, no less ironic, of Gaudí was presented as a *synthetic and dialectic* answer, able to embrace the tradition and incorporate it to the contemporary technological and theoretical innovations: "everything is reused, revised and distorted with a huge effort so much to obtain from each of them a lesson as to go further in the realization of a synthesis" (Solá-Morales 1980, 32).

The eclectic attitude discovered in the graphic selection it is also observed in the selection of the exhibition space, the first project decision. Although the first choice was the Born Market, finally the Salon of the National Palace in Montjuïc would be chosen, precisely at the time when it was in need of a profound restoration. It was in the seventies when, due to its bad estate, the discussion opened between those in favour of restoring it and those asking for its demolition who defining it as a "pastiche."[8] So, this decision in the exhibition project echoes one more time the will to place the school within the contemporary international discussion,[9]recovering this way the academic and eclectic past, and how this "critical attitude" would be assumed as a sing of identity for the future renovation of the school.[10]

Either the revalorization of the controversial space selected for the exhibition, or the organization of its material following the developing of the city, or the realistic and eclectic approach of the project, or the adoption of a critical view that aimed at

[8]Although finally the National Palace would be restored by Gae Aulenti in the 80s (Barral i Altet 1992), some people asserted that, seeing its evident stay of decay it would be better to let it turn into a ruin, since "if it were not for the Museum inside, it would be better for it to fall into piaces" (Barral i Altet 1992, 11).

[9]In the 80s, Rafael Moneo pointed to the eclectic ambience of the School of Barcelona. See: MONEO, Rafael. "Designing and teaching. The reoganization of the school of architecture." In: *Lotus International*, n. 23, Rizzoli. New York, p, 74.

In the same way, Denise Scott-Brown will argue in favour of this attitude at IAUS Forum after the Beaux-Arts exhibition at the MOMA in 1975 by saying that "a thoughtful reassessment of the Beaux-Arts architecture could be a stimulus to new architectural sensibilities for our time, and an important contribution to a nondoctrinaire, humanist, late twentieth century architecture." In: SCOTT-BROWN, Denise. *Forum Beaux-Arts*. In: *Oppositions 8: Paris under the Academy*, Spring 1977, p. 166.

[10]Some writing from ancient professors of the School would be rescued and actualized as the situation of the end of the 70s. This way, Elies Rogent would be remembered when he wrote in 1901 that "we know that the doubt and vagueness which devour us do not let us return to the lost traditional past … so, we must be eclectic, i.e., continuously in search for the unknown." In: ROGENT, Elies. 1901. *Consideraciones sobre la arquitectura de Barcelona desde el Renacimiento*, in the *Anuari d'Arquitectes* of 1901, p. 160.

the identity of the school, are all attitudes discovered in this show to commemorate the centenary of the School of Barcelona and which are framed in a very specific context that embrace the new historical conscience of the critique of modernity. Through the exhibition of an excessive number of drawings, all this sort of shows made of their "products" the indispensable artefacts to construct the "objective" history of each institution. It was in this sense that a realistic approach was possible, not through the presence of the work itself, but through the ideas contained within its representations, the ones to survive in time. So, major discussions did not question the beauty of drawings, but they problematized the *disciplinary drawing*, the *academic drawing*, in relation to the type of professional the architect should perform, i.e., to what extent drawing should be one "instrument" of design used by the architect rather that becoming the architecture itself.[11] In any case, the "discipline" represented by the exhibited drawings was at the time forgotten in the School,[12] and it would be in this way that the "disciplinary drawing" wanted to be recovered. Bohigas precisely referred to the academic type of drawing when discussing the exhibition about the architecture of the Spanish autarchy period, also in 1977. In this occasion he stated that "*the show was an passionate call to the quality of drawing as an autodidact, communicative and rhetorical tool*" (Bohigas 1978, 32).

The Exhibition of the School of Barcelona, as its contemporaries, contributed to the refl on modernity and tradition through "the drawings." Their singularity lies in their capacity to narrate the disciplinary history through what has been considered the most specifi labor of the architect: *his construction activity*, but "construction" was not understood as the technic fact, but as Rossi understood it, in the way that "the constructed architecture is the one which becomes form…" since "technic does not matter, the essence of architecture is not within the technical fact, but in the affi of *construction*, the activity of construction, the specifi task of the architect [will be] *the effort of reason*" (Moneo 1973, 19). It is an idea of architecture that allows the construction of the real and in which the project itself is understood as architecture itself. As Moneo explains, what Rossi refers with "*to construct*" is "to act based on reason, not the materialization of a thought" (Moneo 1973, 6). It was about the affi of the *autonomy* of architecture through the *specifi way of knowing* that architecture has. And it was precisely this what was revealed by the shown drawings, since they

[11]At the Forum followed by the Beaux-Arts show, afterward published in *Oppositions*, Paul Rudolph (1977, 164) characterized the exhibited drawings as the "petrified" ancestors of the commercial images so much valued by the American architects. Ulrich Franzen (1977, 162) would also remark, following Jean Paul Carlhian's testimony (student of the BeauxArts), that those beautiful drawings were not executed by the students, but by other specialized people. In: "Forum BeauxArts." *Oppositions 8: Paris under the Academy*, Spring 1977.

[12]So, in the same way that the drawings of the BeauxArts exhibition were valued because of their "*graphic appropiateness*" by Denise Scott-Brown, from the subject of *Dibujo II* at the ETSAB special *meticulousness in the realization of the drawing* would be required to the students of Barcelona, so they could study in depth the drawing techniques, which required a slow learning. This techniques had disappear in the last years and their lack "had provoked in the students serious damage when expressing themselves at the time of design." See: *Programa de la asignatura Dibujo II* de la ETSAB, Plan 1979.

establish the possibility of what we may fi there would yet be architecture itself. As it concluded the catalogue of the exhibition "it could be no practice without memory" (Solá-Morales 1977); however, a critical attitude should lay the ground for the possibility of an "historical criticism" able to participate of the renovation of the School. As Alan Colquhoun (1983, 39) pointed out "history provides both the ideas that are in need of criticism and the material out of which this criticism is forged. An architecture that is constantly aware of its own history, but constantly critical of the seductions of history, is what we should aim for today."

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Urban Sketching. Drawing on Location as a Tool for Reading Architectural and Urban Contexts

Vincenzo Bagnolo

Abstract Observational drawing ranks among the different features of drawing. It's a basic exercise useful for learning to "see": it introduces basic representative models of architecture and it seeks to develop an individual expression level that will allow students to achieve their own vision of architecture image. This approach is based on the use of drawing as thought, it goes beyond the role of tool and becomes the place where you generate forms. The paper builds on the experiences made with the students of the five year of the degree in Architecture from the University of Cagliari, during the course of Architectural Drawing and Surveying.

Keywords Drawing on location · Urban sketching · Cagliari

1 Introduction

Among the different kinds of architectural representation, we find the study of architecture through observation practice. Drawing from observation can be key aspects of fieldwork during a survey. We have to get away from the idea of drawing as an artistic process: making sketches from observation can be used to represent the different data gathered during a study, it is a way of reading and understanding architecture. Drawing on location does not require special equipment, what matters is to translate what our eyes see, exploring reality through the graphics drawn on paper. Fully versed in the tradition of the teaching of architectural representation, drawing on location remains in the educational courses with its established principles constantly updated (Docci et al. 2011). The architectural representation is developed through a process of architecture deconstruction: it is broken down and brought back to its essential components. The paper builds on the experiences made

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during the course of "Architectural Drawing and surveying" with the students of the first year of the Degree in Architecture from the University of Cagliari. Drawing on location is certainly one of the first exercises useful to train eye, hand and mind in the study of perceivable reality: each graphic sign corresponds what our eye recognizes.

In this approach, the fundamental act is focused in the process of observational drawing, understood as the exaltation and exclusion process of the different detected qualities. The drawing is thought, it goes beyond the role of a tool and becomes the place where the best ideas are generated. In the practice of drawing on location, the research is not aimed at achieving a realism that pursues a "true" representation, but aiming to capture the essence of the conceptual reality verses tangible reality. Through drawing you can bring up the architectural contexts at a primary synthesis scheme, interpreting the structure of our surrounding world. This principle inspired the policy followed in this work: to define a graphical configuration able to demonstrate the structure of the studied context; the final result expresses the formal review process that takes place first in the perception of reality and then in its graphical translation on drawing pad. The outcome is a graphic representation declined according to different degrees of schematization, comply with the ensuing steps developed in the architectural representation.

2 Drawing and Vision

«All landscape exists only for the gaze that discovers it» (Augé 2004, 72). One of the first concepts we learn with drawing is that to draw well, you must first learn to see. Conversely, we can also say that by practicing drawing we learn to see better. "Seeing" is the basis of drawing and, when we are drawing on location, the ability of drawing is inside the act of seeing. Drawing is a substancial act that helps us to see and to have knowledge of the surrounding world. Drawing reactivates the connections to the surrounding world, helping us to form a personal picture of the world around us. Drawing rediscovers rules which modulate and define the image of architecture, in an continuous dialogue between ourselves and the surrounding world: drawing becomes the graphic translation of the human experience of reality. Seeing is primarily a tool to spatial orientation, a means to evaluate and organize spatial events" (Kepes [1971] 1990). I saw, therefore I am: οἶδα in Greek is the same word that is used to say "I know" and "I have seen". The man knows only what his brain is able to see, the view has a dominance over the other senses: only the visible is apparently and, for everyone, unequivocally (Bedoni 2003).

The intention should not be to build a simple graphic simulation: the design should first search for a demonstration of the laws of the observed phenomenon. Learning to "draw what you see" can provide important tools for communication, understanding, and documentation of urban and architectural contexts. Drawing is seeing, and seeing means recognizing, and what is not recognized is not revealed with the drawing. Kant in the Prolegomena says that the intellect does not draw its laws a priori from nature, but it prescribes how it should be (Cassirer 1999). Similarly, in the act of drawing we impose our vision to investigate an architectural context. Starting from the same image, our vision can lead us to the configuration of several different messages, whose coexistence returns the representation of a range of apparently contradictory different aspects of the same reality but likewise all equivalent to each other (Goodman 1988).

3 Drawing and Thought

The visual experience leads us to use models to represent reality resulting from the individual thought patterns, subject to changes over time. The draw allows us to think, and drawing means having to set our ideas. Visual thinking, in the double sense of expressing or showing ideas, plays an essential role in the graphic translation process from real to virtual world and also producing images of the ideas with a charge and a wealth that can never be reached by the words.

Pablo Picasso says to paint objects as he thought them, not as he saw them (Galenson 2006, 9). In this statement the image of the world becomes a central element in the construction of knowledge, it is the fruit of the mind that goes beyond sense experience and becomes thought. Recent studies have shown that seeing is already thinking, there is no reducibility of representational property to a code of mental representation more abstract than this one (Di Napoli in 2004, XVI). While the design is thinking the graphic expression will never be exceeded by the passage of time, when the drawing itself is the event, and it is the vehicle of thinking of all times. Drawing is a way of thinking and different ways of drawing determine different ways of thinking.

4 Drawing and Knowledge

The modern gnoseological problem lies in the relationship between subjective mental representation of the world around us and the objective external reality. Traditionally, we have moved on the dichotomy between the seen and the unseen. This dichotomy can now be considered outdated, what we have seen is a part of reality and its worth depends on our ability to see: only by penetrating the subject of appearance, we can find the hidden reality (Colli 1982, 305). Dealing with the relationship between reality and its possible representations Paul Klee wrote: “Art does not reproduce the visible; rather, it makes visible” (Klee 1957). Reality can not be reproduced as such, the vision is not a passive process but a process in which the human visual system is actively involved: the visual message varies according to the visual experience and its arbitrariness. Merleau-Ponty expresses the relationship between reality and its different representations according to a "magical idea of visibility" (Carbone 2008, 44). As part of the pictorial research, the Renaissance first raised the issue of the scientific value of the graphic representation of the space. This trend in the arts leads to a rationalization on the mathematical level: it is assigned an universal value to the graphic representation of the space, with the intention of matching together the creative process and the cognitive process, elevating the art to science.

Nelson Goodman operates an equivalence between art and science, emotional world and cognitive world cannot be separated: in the aesthetic experience the emotions function cognitively (Goodman 1976, 215). According to Konrad Fiedler both the artistic representation and the graphical representation based on a scientific conceptual construction, are two attitudes that involved a process of knowledge of the phenomenal reality: the value of artistic skills is the ability to extend the knowledge in those areas where the causal connections lose their meaning (Vozza 2001, 54). Piero della Francesca reinforces the idea that reality is not represented by copying the sensible world, but its representation implies the passage that brings back each figure, to the construction that links them to the ideal model of regular solids (Fantuzzi 1974, 558). Each graphic model of reality is a simplification of the real world intended to promote understanding. The process that accompanies the graphical representation can be summarized according to three phases: the perception, the construction of the ideal geometric configuration, the realization. The geometric abstraction introduced by the perspective does not return an objective view of reality, but, on the contrary, it gives to the world of shapes the characteristics of an intellectually refined conception of life, as in other expressions such as philosophy and literature (Fantuzzi 1974, 558). Cézanne, in a letter of 1904 to Bernard says: "Treat nature by the cylinder, the sphere, the cone, everything in proper perspective so that each side of an object or a plane is directed towards a central point" (Fantuzzi 1974, 558). Cézanne founded the structure that holds and organizes his perceptions on the construction of the ideal geometry, creating a reality in which man is the author. The drawing, like any other language, is not to be conceived as a cast of the reality, but it must be understood, in analogy with the verbal language, as a particular organization of the data of an experience (Fantuzzi 1974, 557).

The aspiration to recognize the primary elements that reduce reality to elementary forms, would seem to correspond with certain attitudes of the specialized areas of the visual cortex, responsible for processing visual information. Point, line and surface—to say it with Kandinsky—are elements of selection and systematization of visual language: they are the product of the eye-brain system, that acts with its own autonomy and independence. This leads us to consider the drawing as the result of a mental process fully rational and objective. But if the drawing was simply the result of a self-sufficient predisposition of our mind, this would reduce to zero the role of the "hand", weakening the weight of the visual experience in the drawing process. Going beyond the definition of phenomenal optical-perceptive values, the drawing has its emotional charge and expressive power. The power of drawing is revealed through the aspiration to overcome the concept of representation in the search for a graphic expression as an act of knowledge and a visible sign of the proprietorship reality. Drawing, among various forms, can be taken as a translation of the conceptualization of visual experience: the man represents to himself something, this is despite the knowledge (Colli 1982).

In the preface to the text of Gyorgy Kepes "The language of vision" Hayakawa said that every language "is both a tool and a trap" (Kepes 1971, 10). Regarding the question on the realistic representation of the sensible world, and on the existence of a universal graphical language which expresses a constitutional function of the human being, Pierre Francastel says that believing realism of linear perspective is to believe that only one language group can express all the semantic needs of humanity (Marci 2014, 212).

The drawing has an instinctive power bound to the conventional system of signs and graphic symbols. The drawing is an expression between the symbolic language and the instinctive act. The drawing is both a language and a undisputed cultural product of all times, characterized by aesthetic and symbolic codes shared by the dominant culture of each historical period (Di Napoli 2004 XVII). The image, beyond the role of a medium of the "real world", assumes its own significance and expression, self-loading itself of meanings than the represented reality. Often these values are those that belong to the relative reference graphic language, distinctive of the cultural context in which the image is conceived and formed. In any graphical representation, the iconographic codes of the past are renewed from time to time and the drawing loads of independence, with a self-determination of the essence within itself in comparison with reality, taking its own intrinsic value that goes beyond the mere recording of reality and manifesting the cultural power, peculiar to a certain era. By understanding how the graphic expression be subjected to visual references inherited from tradition, the man proceeds to renew the old visual thinking models, updating and modifying them in order to make them suitable to express the new "views of the world". So did the Impressionist movement, rejecting the thought patterns of tradition and aiming for the revaluation of perception as an autonomous operation of the mind and an irreplaceable experience of life. The graphic expression by language becomes meta-language; It develops its internal dimension which is the reflection on the specificity of his means of expression (Fantuzzi 1974, 558). Among the different languages, the graphical representation is able to spread knowledge more effectively than almost any other medium. Visual communication is universal and international (Kepes 1990, 16). Leonardo is a firm believer in the importance of visual language (Calvino 2000); he noted in his notebooks anatomy: "O writer, with what letters can you convey the entire figuration with such perfection as drawing gives us here? […]; do not try to convey to the ears those things that pertain to the eyes, because the painter will be vastly better at it than you" (Kepes 1990, 16). Leonardo not only he believes that the design exceeds the word, but is most effective in the same reality (Veltman 1982): «And you who say That it is better to look at an anatomical demonstration than to see These drawings, you would be right, if it were possible to observe all the details shown in These drawings in a single figure, in cui with all your ability you will not see, nor acquire knowledge of more than a few vessels» (Heydenreich 1954, 125).

5 Drawing and to Draw

Through drawing we can build figurative spaces that simulate and revise reality. In his dictionary Francesco Milizia says that drawing is the art to imitate the shapes and contours with traits that we have to view objects (Milizia 1797, 220). Milizia defines drawing as "the art of imitating", and we must approach it starting with the freehand drawing of geometric figures. From his point of view, this exercise is necessary to pursue the "rightness of the eye", necessary because everything in nature can be reduced to a combination of geometric figures. Starting from some example drawings, Milizia suggested the second exercise: to redraw the figure contours and, subsequently, to apply the technique of light and shade. Through the graphic transposition, the abstraction process is intended to define, first, the essence of the sensible reality, bringing back the unitary system to a combination of basic geometric entities. The activity starts with some preliminary observational drawings in which we can investigate the context from different points of view, with the aid of some quick sketches. At this stage, the comparison with reality is characterized by the freshness of the graphic trait, defined by the fast and instinctive movement of the hand drawing, that interprets the structures and connections of reality mediated by thought. The drawing decrypts from reality and transposes on paper a few moments of the dialogue between the observer and the represented environment: an endless

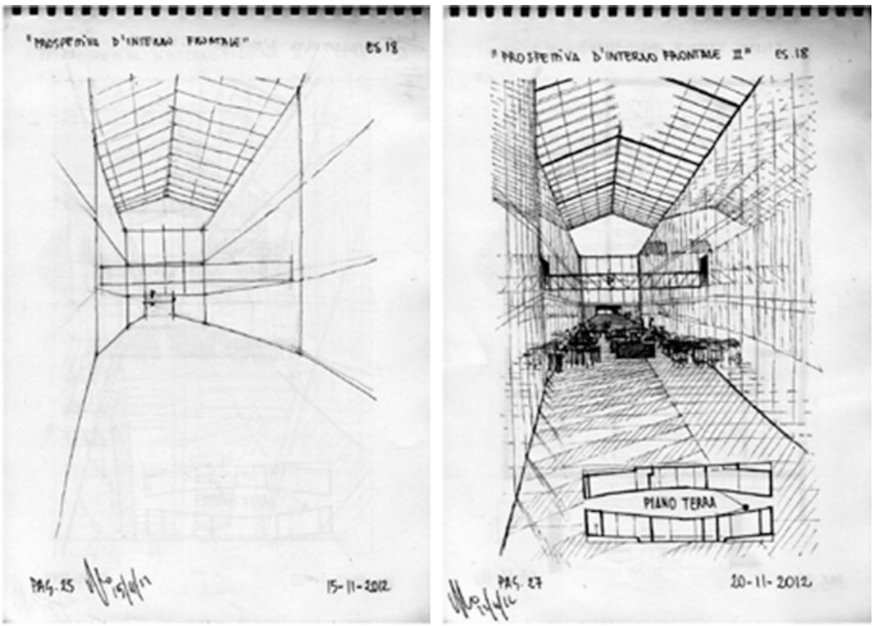

Fig. 1 Graphic interpretations of the interior of the MEM in Cagliari (Drawing by R. Simonetti, AA 2012/13)

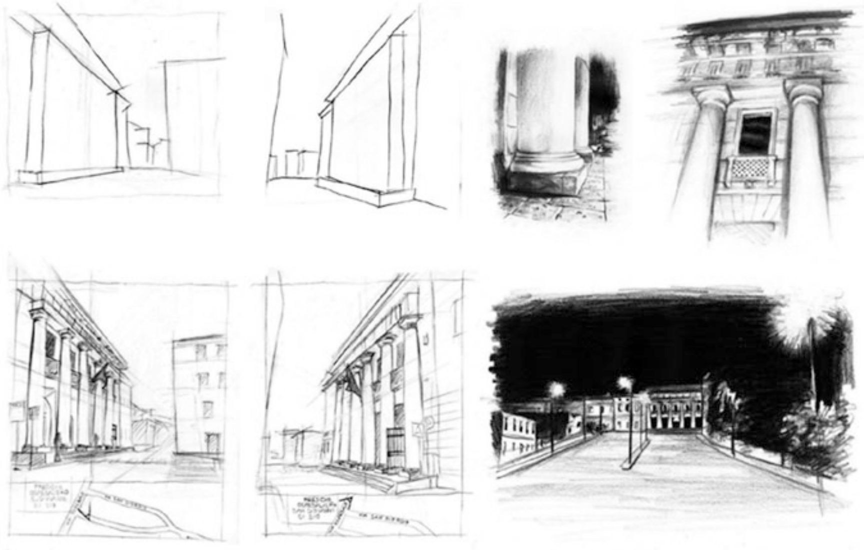

Fig. 2 Study of the main front of the hospital San Giovanni di Dio in Cagliari (Drawings by M. Rosas, AA 2012/13)

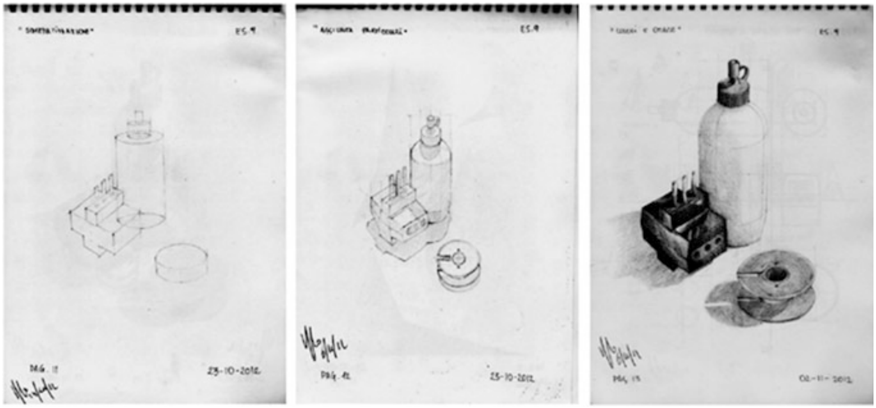

Fig. 3 The three-dimensional representation is expressed through three processing, each one corresponding to a different level of reading and interpretation of reality (drawing by Simonetti R., AA 2012/13)

dialogue that needs to catch up, rather than the appearance, the essence of things, and that returns visions no less true of those who attend habitually (Abrams 2014).

The capability to see and penetrate the essence of the multiple "objective realities" revealed by the eye, should result in the ability to express the recognized structure through a few signs, thanks to a geometrical abstraction that crosses the

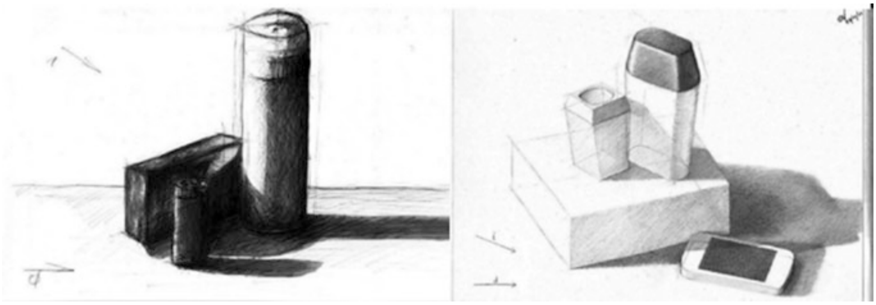

Fig. 4 Two examples of final processing drawings (drawing by Rosas M. and Tetti V., AA 2011/12)

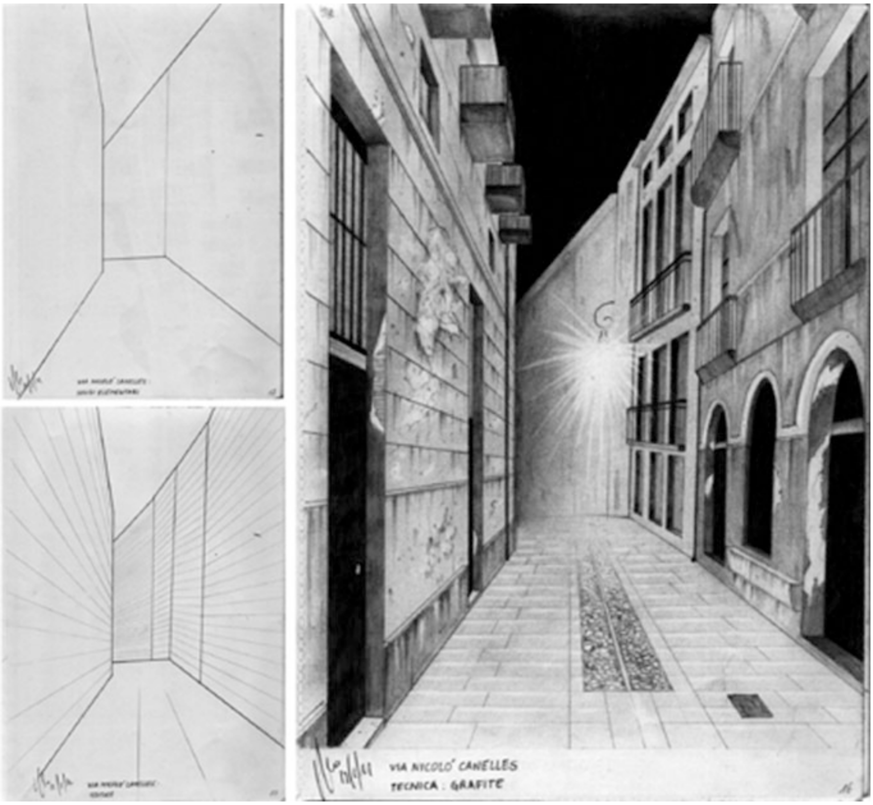

Fig. 5 Graphic interpretation of a view of the Via Canelles in Cagliari (Drawing by Demurtas G., AA 2011/12)

barren realism. The friction between realism and geometric abstraction, builds the idea, and returns the character of the different elements and different relationships identified, trying to go back to their primary structures. Represent reality in a direct approach, it means looking for the detection of different parallel worlds. All graphic representations are equally valid paths to observe the sensible world: any representation is equally true, which is the same as telling that they are all equally fake. Represent reality going beyond the realism of the conventional visible world means changing the signs, and not just what they say: it is to recognize new configurations in the nature, basing research on the liberty to interpret and to signify things (Barthes 1966, 354). When we translate an object in his depiction, the drawn line is the reduction of the object to something that does not exist as such in the nature but that, as an element of visual attraction, exists in the human mind. In the representation of architectural and urban landscapes, through the process of deconstruction and reorganization, which takes place in the drawing, the investigated landscape is brought back to the definition of plans, axes and lines that, in a still iconic representation, helps us to strengthen knowledge and communication of the essence of reality. In reporting architecture to its basic shapes, revealing the lines

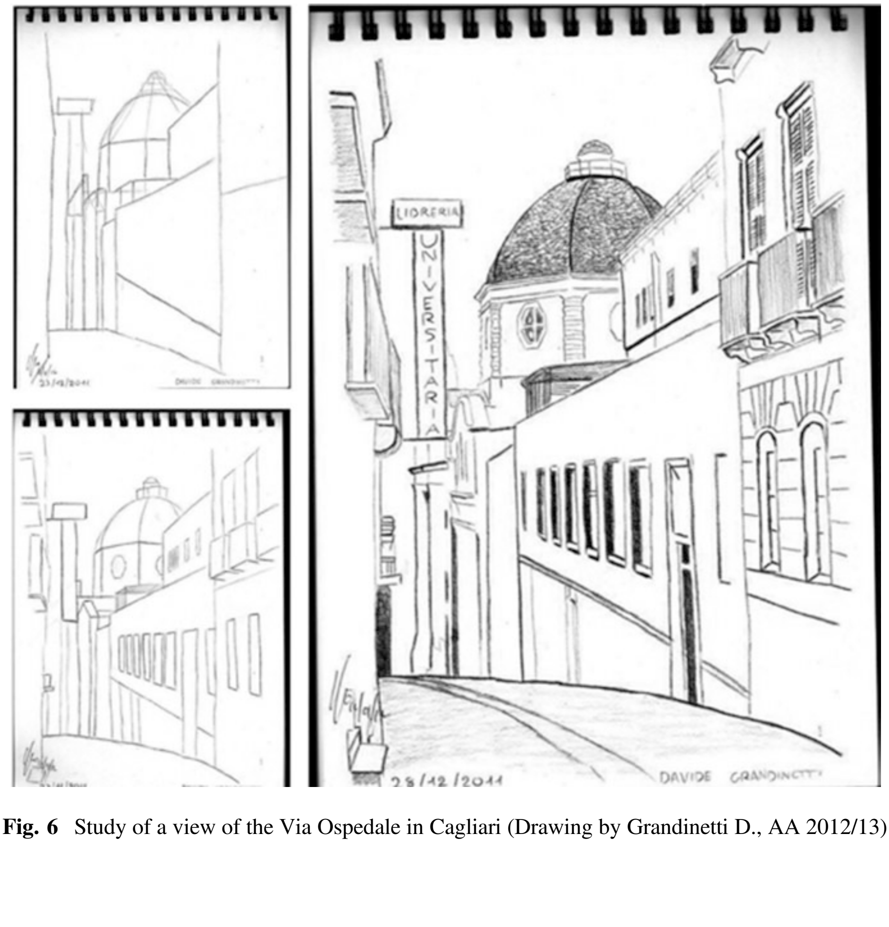

Fig. 6 Study of a view of the Via Ospedale in Cagliari (Drawing by Grandinetti D., AA 2012/13)

with the specific character and significance, it was a major objective of the exercises of “drawing from real”. The aim should not be identified with the construction of a “realistic” representation: the aim must be to a drawing that gives shape to reality manifesting a reflection of how we think the specific reality represented.

The work was carried out in some urban areas of Cagliari. The very act of drawing, even in a context well known, reveals new meanings to our eyes, escaped our gaze until then. The design becomes the witness of our personal vision: discerning different elements, you learn to read the structure of the architecture and the urban environment, including the meaning, the value and criticality. The act of drawing goes beyond the pure urban graphic documentation, assuming the role of a workout for a “critical view”. Besides learning to see, drawing on location is an

Fig. 7 Study of a view of the Via Azuni in Cagliari (drawings by Grandinetti D., AA 2012/13)

essential exercise to achieve the understanding of urban and architectural space. The drawing becomes the intermediary for the “structuring” of the built environment, through the recognition and enhancement of the key features. To understand the context in its various features, these exercises require students to proceed through a “deconstruction”, with the aim of finding some of the “established” rules.

Reducing sensible reality according to the scheme introduced by the drawing, must tie architecture to its principles of order, bringing back a meaningful summary graphics. The graphic representation is the final outcome of one of the many paths of knowledge that can be put in place by drawing: the translation process that is to be realized is not unique, it admits different “definitions” of architecture and lends at the same time to multiple interpretations. Ackerman calls “precision” the variant of subjective connotation that characterizes every graphical representation, including photographic representation, being submissive to the same personal and cultural values that influence the drawing (Ackerman 2003, 261): communicative intent, desired effect and its aim, together with the choice of the method of representation and of the graphic technique, are all already discriminating factors for themselves. In the experiences carried out with students of the first year of the Bachelor Degree in Architecture from the University of Cagliari, these exercises introduce to a path that begins by “learning to see.” The act of drawing is one of the instinctive gesture and rational interpretation, which characterize the three functions to read, record and tell the sensible reality, or an idea or an emotion. The investigative contexts are the historic districts of Cagliari: through the exercise of drawing on location the students were constantly pushed to experience the world

Fig. 8 The church of Santa Chiara in Cagliari (Drawing by Boi I., AA 2013/14)

Fig. 9 Study of a view of Via Santa Croce in Cagliari (Drawings by R. Simonetti, AA 2013/14)

Fig. 10 Studio di uno scorcio della via Corte d'Appello a Cagliari (Disegno di Ungredda E., A.A. 2013/14)

around them in a debate with themselves, with their skills of observation and synthesis reading and communicating the urban landscape and built heritage.

The first drawing required students, consist of the interpretative scheme of the site plan. This exercise requires a level of abstraction that, in the graphical depiction, puts the point of view in a fictitious position that does not coincide with the real observer's eye position; this involves overcoming the drawing as an imitation of sensible reality, imposing a "definition" of the architectural and urban space (Figs. 1 and 2).

The process of transferring continuous models of reality into discrete counterparts of a planimetric two-dimensional model, aims at the understanding and representing the shapes, the relationships and the spatial distributions of the built environment. It was later used the method for perspective: bring the built enviroment to the perspective geometry it means to operate a drawing through the codes of the geometric-mathematical model of the Alberti's "costruzione legittima", which provides a surrogate for the "experienced perspective model". In the different drawings, the line has been the main element of visual attraction. The goal was to return a graphic synthesis to translate both the objective spatial laws and the individual personal vision of each one: the sketchbook is also the opportunity to share subjective views with others. The fieldwork was preceded by some practice in sketching and drawing from observation. The first approach is introduced by some preliminary graphics exercises. Learning the method starts from its application in the study of a composition of small objects (Figs. 3 and 4), to represent in a program of procedures similar to those of the later study of the architectural and urban landscape (Figs. 5, 6 and 7). The work included a process that develops with progressive levels of difficulty starting from the representations of the composition in an orthogonal projection, we pass to the study of isometric and perspective projections, and concluding with the issues related to the theory of shadows and graphic rendering (Figs. 8, 9 and 10).

In particular, the work involves a drawing to be realized in axonometric projection and articulated on a three stage sequence: taking off the setting of a first scheme, it passes through the drawing of the volumes and the graphic characterization of the different surfaces. The three-dimensional representation is expressed through three graphics processing, each one corresponding to a different level of reading and communication. The exercise is expressed in a bounce between the scale of the urban space and that of the individual building. Through parallel and central projection, the study aims to emphasize both the relationship on the plan and the connections of the built environment in three dimensions.

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Urban Landscape Analysis. Graphical Representation of "Castello" in Cagliari

Andrea Pirinu

Abstract The present contribution shows a selection of drawings made by a class of students engaged in representing the Castello district of Cagliari. Through urban sketching, graphical elaboration of photographic images and retracing the forms determined by the interaction between architecture and nature of places, it's possible to perform some interesting readings of the image that represents the city of Cagliari. A drawing and a re-drawing conduced with the traditional tool and the times that characterize it … a drawing in which every minutest observation was determined by a specific choice which was followed by a precise pencil line (De Rubertis 2009).

Keywords Urban landscape · Urban sketching · Cagliari

1 Analyse and Represent the Landscape

The analysis and representation of the landscape acquires particular interest if referred to the recent definition of landscape proposed by the European Landscape Convention.

The recent definition of landscape complements and broadens the definition of territory. In this new idea of landscape, the "description through graphical signs" of physical and human elements that characterize a specific part of the territory, is strengthened by the relationships between these components and by the contributions related to the perception that involves all the senses and gives a weight to the elements of the landscape, giving a sign, a value, a judgment—the outcome of their interrelation—that individual or a plurality of individuals has of a particular "place".

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The representation of the territory and of the landscape is an ancient form of language, an indispensable tool used by the man to control it and solves the need of "concretization of existential human space, intended as a physical extension of the image that everyone has of himself and of his environment" (Cianci 2008).

A constant application conducted by the man throughout history; application that is expressed through the graphical and later cartographical representation of the territory, according to a process of coding and attribution of meaning to the signs and images, with the aim of defining a knowledge framework of the physical and human components and highlight a specific configuration of the landscape, a compositional interpretation or hierarchical organization of space.

Viollet Le Duc defines The Massif du Mont Blanc like a big building and claims that relate to architecture and relate to nature is the same thing because on either we can carry out the same analysis, the same geometric investigations.

According to this declination, the landscape can be understood as an architecture and divided into elements whose interrelation defines its shape, a balance that can be read, investigated and found through the drawing.

The learning curve of the territory and landscape defines as ultimate goal a reproduction and then the imitation of a real condition; this condition is obtained through the acquisition of a largest number of information and indications useful to a qualitative analysis.

Between these two operations, stands the time of analytical evaluation—intended as a decomposition of the object investigated into its constituent parts—followed by the description of these parts and between the part and the whole.

This step takes place through the drawing that, as a technical language and not the product of an innate skill, contains the languages and the objective rules that can record material and physical qualities of the objects and their spatial and temporal relationships.

This process is achieved through a re-composition of the results of the research and reveals—through the forms of his own language—the significant elements and identifying characteristics that qualify and divide the territory as a set of homogeneous entities commonly perceived as places.

The landscape analysis through the drawing and communication of its representative signs can and has to acquire a research character and has to find an application in teaching when facing the "problem of representation" that derives from the relationship between the results of the survey and the expressive language (both conditioned by representation methods and techniques for data acquisition).

In particular we refer to the current condition of great "quantity of available data—in particular due to the recent survey methods—and to a research aimed at a" "high level analysis" related to the influences of perceptual experience where the interest move decisively from the amount of operations to the quality of the data and their interactions, meanings and differences responsible and representative of a graphical model, synthetic and opened that contains the ways to describe the indications for an achievable future or the "solidifying and overlapping of the signs of history in a form" (Gregotti 1982).

A research aimed to show—through graphical signs—some aspects, in particular of the urban landscape, related to the “perception of a space by a community and to the need for its control and planning as a tool to start a regeneration path of the urban fabric that is expressed through its representation (Lynch 1964).

Then, what is the most correct drawing to represent the urban landscape and what is the graphical representation of the city best suited to describe his “sign”?

The representation of the landscape, according to the graphical techniques used, can rely on a dual type of approach: analytical and numerical or visual and intuitive, each one with its own expressive repertoire, that we can and must integrate in order to reach a better understanding and a better communication of the peculiar aspects of the field of investigation.

The development of data acquisition techniques and increased capabilities of computing that characterizes software and hardware dedicated to the computer graphics, support the possibilities of gathering information and therefore a knowledge of the sites—supported by photogrammetrical and laser scanning survey methods—where the development of computing algorithms make possible a processing of complex shapes such as those that can be found in today’s landscape.

A process that requires a phase of data interpretation in order to conduct to a “survey as a tool for a well understanding “, exploration tool able to “analyse and represent” characteristic and unique signs of a changing landscape that still preserves the traces, the supporting frame and its identity, the matrix of any—past and future—design operation.

Together with the digital representation methods the traditional drawing still “exist”; this way of drawing, related to a visual and intuitive approach in which “the empirical observation of the displayed optical cones captured by a camera shots along with drawing on location, represent the most intimate message that we can deduce from the suggestions that the environment gives us” (Cianci 2008).

That representation based on the information taken on the “scene of the place”, an expression commonly used by Savoy engineers to indicate a direct process of territorial recognition, the glance on the territory (Zedda Macciò 2004).

The graphical representations of the city are divided into two categories. Each one of them offers a complementary way of seeing and telling the places through the drawing: top views of urban shape—that shows the whole city with a single view and perspective views, purposefully partial.

The first representation, obtained from aerial photography and aerial surveys “provides an image conceived as an idea in two dimensions” (Rossi et al. 2014) who delivers a topographic survey and highlight the organization of the urban fabric and its relationship with the territory catch in a unique view, “an image far from the reality that perceives the human eye and far from the feelings of the person who stroll through the city (Báez 2012, 10),” the image of the city, in fact, escapes—for his multiple levels of stratification—from the symbolism of maps (Manganaro 2011).

Otherwise, urban vistas offer a choices views of the highlights, with portraits recognizable in their visual reference to the urban space.

Maps and zenithal views are important tools for a correct analysis of a urban form defined by physical elements, recognizable as a preordained design, which is difficult to reconnect to the perception; the views instead describe the visual image for chosen/selected fragments, which can allow an immediate recognition of the places.

Thus, the urban vistas integrate the informations present in the map with "a change of scale that adds the third dimension to the architecture, even bringing back to man the greater human dimension" (Rossi 2014).

The urban vistas represented—in different historical moments—the way to communicate the urban image with increasingly accurate models of representation of her beauty and traditional symbols.

Each view contains a message where the artistic dimension (which includes and requires the contribution of perception) with the narrative meaning (objective documentation) define a complex drawing.

Since the first representations each city shows its best profile to the work of painters in a kind of portrait pose, controlled, full of formality and emphasis (Cadinu 2012) that is for the city of Cagliari the skyline of the district of Castello.

The long tradition of seeing and portraying, in an increasingly open and easy to read dialogue with the urban and monumental composition of the city, still find in the drawing a tool that—more than any other—translates the thought and human emotions and deliver the images of "a complex design where the relationship between drawing and seeing, between doing and simultaneously discovering the things is precisely the essence of thought" (Chiavoni 2014).

2 The Landscape Drawing (D-Sign) and Its Formative Function

Draw the landscape acquires a significant importance in the training of students of architecture and in general for those who work in the field of architecture on the scale of the monument, the city and the territory.

The activity of reading/analysis of the signs of the landscape enhances the ability of observation and sensitizes an attitude of care and constant attention to the dynamics of transformation of places.

Observe an architecture and perform a sketch is a functional activity aimed at the development of the analysis capabilities of dimensional and architectural elements that compose the object of survey and of the whole object.

This activity encourages the development of sight analytical skills through the acquisition of the dimensional relationship between the parts of the object, the acquisition of the architectural details and the evaluation of the weight of these in the overall design of the artifact.

The change of scale from the survey of the monument to the survey of the landscape retains the same methodology, aimed at the selection of signs/parts of the landscape itself and determine its composition, its form.

Acquire a good observation skills of the urban and architectural heritage allows to perform a constant monitoring of its development process that facilitate the analysis of the aspects related to urban diversity and become the starting point to contribute to sustain it and enhance it, becoming a tool for analysis and design.

The analysis of an urban context through a life drawing can happen in different ways. Through quick sketches, done in a limited time, which secure fast and fleeting impressions derived from the casual impact of the eyes on the reality that, in most cases, capture only some aspects of what we see and recognize. Other times, however, a more careful representation, performed in a longer time, can bring with extreme fidelity the slow path that the eyes makes analyzing the elements and also reveal the hidden relationships between the objects and the traces left on them by time and use that underline the history experienced.

This approach is close to the practice of photographic images re-drawing; this images performed by privileged viewpoints are graphically retraced and deliver some important readings/analysis and identify objects and meanings escaped to a "first sight".

Within the representation process of the landscape, life drawing and urban vistas, drawing from memory and elaboration of photographic images become part of the graphical documentation and of the analysis process that find in the drawing made with traditional instruments and in the times that characterize it, that graphical operation in which "every most minute observation was determined by a specific choice which has corresponded a precise pencil line" (De Rubertis 2009).

In particular, the life drawing, needs—as a basic condition—a direct contact with the theme that has to be represented, the choice of the repertoire of signs able to translate the characters of reality in an image and an examination of forms, proportions, location, of light, of all things, to reach a strongly characterized graphical synthesis (Docci et al. 2011, 76).

It is a subjective act, conditioned by the language and the tool used by the author and the author's culture; provides an image far from the analysis that we obtain observing the plan of a city or an urban space and completes the knowledge thanks to a different image of one who is immersed in the environment and has feelings.

A complete "way of feeling" not a simple "way of drawing" and train the visual memory leads to expand the patrimony of experiences from which is useful—as well as analysis and reading—for any compositional activities, because "no one can have a beautiful image in his own imagination if he has not filled the mind with many life drawings" (De Fiore in De Sanctis 2012).

The drawing from memory requires a training of sight and attention, strengthens the capacity of elaboration and visualization of what is seen and can provide useful information related to the weight (subjective analysis) of the elements that characterize the landscape.

The analysis of views, conducted through "empirical drawings and intuitive representations" (Pittaluga 1984), requires a choice of the point of view and a selection of the landscape elements and of the graphical sign, which is a function of the importance, the value attributed by the observer.

A method that is functionally to an analysis linked to an individual “in close contact” with the environment and not to a “cold observer” which carries a collection of data that today have become redundant where “the primacy of the accuracy on the clarity of expression it is a fairly recent communicative and cultural derailment on which it would be worthwhile to reflect” (Valerio 2014).

Different mental processes translated through the drawing will aim to provide a “representation for signs” of landscape components, to identify the forms and the peculiar aspects through the use of different tools.

The different expressive possibilities offered by the use of pencil, pen and marker will lead to the creation of a graphical repertoire aimed at the “communicability” of the results and will allow different abilities (characteristics of the individual designer) to express their mental images with their own shape and strength.

If the pencil offers the possibility of subsequent steps aimed at strengthening and highlight certain aspects and allows to return to the drawing for further investigation, the pen and the marker do not allow a second thoughts and the sign that comes in the moment of the “reading places in the places” is the result of an instinctive act —as the sketch—the first sign, that returns a particularly interesting information that makes manifest an extreme synthesis of perceived signs; a seen, recognized, processed and presented signs.

The accuracy of the data, represented by drawing, is not a goal to be searched or exasperate because “it is not possible to define the limits of precision of a correct survey, because we can be considered a survey whatever documentary representation performed next to the operation of reconnaissance and observation of the architecture, and graphically translated in any approximation” (Vagnetti 1958, 90).

This interpretation can be extended to the survey and drawing of the landscape, where every form of reading/analysis contains some information and represent a useful contribution to a complex reading. In the urban landscape application carried out has been preferred the choice of the search of the “sign” without considering the results (also important) obtained by the color analysis—that is the first thing that catches the attention of our eyes—and the representation of the green, elements of certain importance to determine the final configuration of the landscape.

3 A Teaching Experience: The District of Castello in Cagliari, Sign of/in the Urban Landscape

The learning curve inspired by drawing proposed to the students finds its motivation in the utility and wealth of a analysis operation, recognition, coding and representation by graphical signs of the city’s images that find in the district of Castello and its skyline a strong element of recognisability and identity of the places.

A way of observation and search, exercise and constant activity of relating at different scales with the forms of architecture with the aim of in-depth knowledge, increasing the skills of observation and synthesis, identification of traces that keep "readable"—even after the most recent transformations—the city's image.

The different evaluation methods require a full immersion in the landscape, in its lines and its forms responsible of a dynamic equilibrium, of a drawing that continually changes.

An exercise carried out with different graphical techniques and a graphic-representative baggage strongly linked to a translation ability of a mental elaboration that find in the traditional drawings the representation and communication tool.

The survey method requires the choice of a view: a very interesting document—realized before the late nineteenth transformations—is represented by the "View of the City of Cagliari, capital of the Kingdom of Sardinia, the side of Villanova, then of Levante in 1825".

The view portrays, from a location near the hill of Monteurpinu, the medieval district of Castello and of Villanova.

We can easily observe the profile of the fortress and the medieval settlement in its full extension.

The monumental complex of the Cathedral, the tower of San Pancrazio and the tower of Lion characterize a profile that follows the morphology of the fortress where the high medieval walls accompany the strong elevation change that separates the district of Castello from the lower city.

The characteristic signs—that we called "landscape components"—of the Eastern front are also represented by the homogeneous character of the buildings located in the monumental complex of the bastion of Saint Remy and the vaulted structures near the bishop's palace.

The view presented in the foreground the church of San Lucifer which identifies the position of the observer and the landscape of cultivated fields near the Villanova district in which "stands" (exaggerated and quite idealized as the Church of St. Lucifer) the belltower of the Church of St. James (Fig. 1).

A large selection of landscape elements are shown in some graphical readings proposed by the students who observe, interpret, and return the current image of the eastern front of the Castello.

The selected drawings use various graphical techniques; the life drawing in Fig. 2, with a considerable balance in the use of the graphical sign and in the dimensional and spatial relationships, highlights the formal compactness of Castello, overlooking the urban context and emphasizing the strong presence —"natural and vertical"—of the rock dominated by a few elements such as the Cathedral and the tower of San Pancrazio and a recent "heavy" element—the Belvedere palace—located in the right part of the drawing—that modify the historical urban skyline of Cagliari.

The monumental architecture dominate the landscape not as architectures of important size but because overlook small units; This is the art of the relationship (Cuillen 1976).

Fig. 1 The skyline of Castello and of urban context in the 1825

Fig. 2 The skyline of Castello observed from the hill of Monte Urpinu: life drawing by Giancarlo Sanna

The use of pencil leads to a “soft, plastic and compact” representation that does not express the “naturalness” of the rock.

The descriptive frame is completed by the mountains placed into the east of the city and the clearly visible sign of wind turbine blades, a landmark in today’s urban landscape.

The same author makes two other drawings; using a pen and starting from a photographic image offers a first synthesis that distinguishes the Castello from the most recent volumes and a second representation aimed at enhancing the verticality of historical architecture, with “natural” irregularities of the rocky ridge enhanced by the “roughness” of the tool adopted.

With the same attention and with a graphically retracing of the landscape signs are proposed the “readings” in Figs. 3 and 4 which are distinguished by an

Fig. 3 The skyline of Castello observed from the hill of Monte Urpinu: graphical synthesis by Giancarlo Sanna

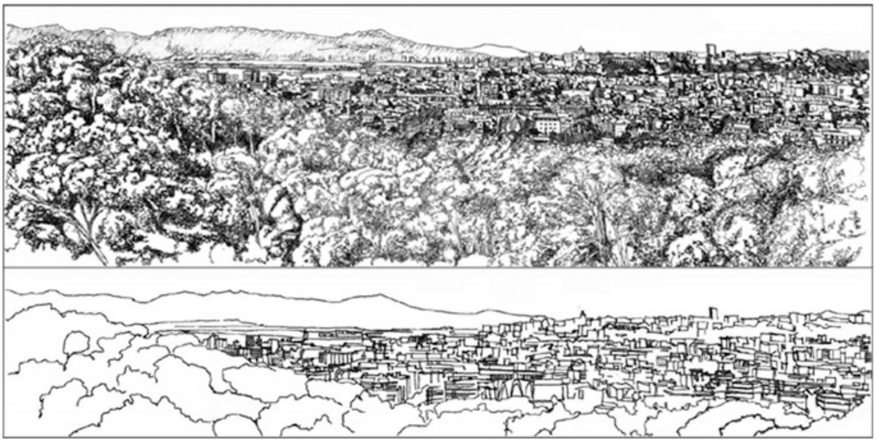

Fig. 4 The district of Castello and the district of Villanova seen from the hill of Monte Urpinu by Stefania Contini

exaggerated detail—a passage that is sometimes necessary to "discover" hidden qualities—and a volumetric analysis realized with an elimination of the unnecessary signs.

A graphical synthesis of a narrowed area is shown in Fig. 5; here, the attention has been focused on a sector "limited" by some architectures necessary to guarantee to the representation a balanced composition: the photographic image processing is described through a process that starting from a precise re-drawing leads to the volumetric analysis, to the selection and detail of certain architectural emergencies and a synthesis—"graphically assisted"—that highlights the most complex design

Fig. 5 The district of Castello and the district of Villanova seen from the hill of Monte Urpinu by Manuela Serreli

Fig. 6 Life drawing by Adrian Lipowski

matrices and modular grids that—in the twentieth century—modified the vertical sign of the skyline of Castello. Life drawing, photography redrawing and drawing from memory are available in the 6-7-8 figures in the first two drawings we observe the contraction (life drawing and drawing from memory) of the landscape components and how the student represents with a good proportion the dimensional relations and the distances between the architecture, cleary marks a distinction between the district of Castello, the district of Villanova—represented as a great "urban stain"—and building scenes in the foreground, with a focus on the Justice Palace and the Church of St. Catherine (Figs. 6, 7 and 8).

The drawing from memory that completes the sequence of elaborate "retains" some objects of Castello (cathedral, medieval tower and vaulted structures located between these monuments), the presence—chaotic and uneven—of Villanova district and its recent expansion, and in the foreground, the public and religious

Fig. 7 Graphical elaboration from a photographic image by Adrian Lipowski

Fig. 8 Life drawing by Adrian Lipowski

Fig. 9 Life drawing by Erica Olianas

buildings constructed in the twentieth century. Concludes the selection of the work a life drawing (Fig. 9) in which the highly realistic representation is shaded and reinforced by the filling of green spaces.

4 Conclusions

Different graphical readings and several graphical codes were used in the drawing of urban landscape of Cagliari and his most representative element, the district of Castello.

The research has found in a teaching program the “place” of application of tested methods and experimentation of graphical techniques useful to describe the city and to express what was observed, experienced, understood and realized by a class of students in contact with the forms of the urban landscape and their ability to extract information; this learning curve aims to a better understanding of the dynamics of a changing landscape functional to the project or more simply—but with a greater importance—to an awareness of the values related to urban diversity, the starting point to contribute to support and enhance it.

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Freehand Drawing: From Tradition to the Present Day

Emanuela Chiavoni

Abstract The study of past artefacts as well as representation methods, graphic systems, behaviour and calligraphies are all crucial in the process traditionally used to understand real life drawings of our architectural and urban reality. The representations executed in academic circles are a good starting point because these drawings portray not only the memory of the places in question, but also the educational approach used over the years to train architects.

Keywords Drawing · Analysis · Architecture

1 Premise

This contribution begins by analysing and interpreting the graphic documentation currently housed in the Historical Archive of Drawings (Rome) of the former Department of Survey, Analysis and Drawing of the Environment and Architecture (Radaar).[1] Several drawings of the city of Rome were then selected and the same urban reality represented in those drawings was redrawn from the same viewpoint in order to compare and critically assess the two different images. The aim was not only to compare and highlight the changes to the areas in question, but also reflect

[1]All the archival material is housed in the DSDRA Department in piazza Borghese 9 in Rome. The Department of History, Drawing and Restoration of Architecture (DSDRA) was created on 1 July 2010 when two pre-existing departments were merged: the Department of History of Architecture, Restoration and Conservation of Architectural Heritage and the Department of Survey, Analysis and Drawing of the Environment and Architecture. The new Department was part of the reorganisation programme of the "Sapienza"—University of Rome.

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on the way in which the drawings were made and review the graphic choices. The study examined their geometries, representation methods and different calligraphies and also focused on discovering why the drawings were made and which graphic techniques were used in each drawing.

The original archival drawings, all on paper, are currently being digitalised[2]; they constitute an important collection of graphic material produced during the courses on *Survey of Monuments*, *Elements of Architecture and Survey of Monuments* and *Real Life Drawing* held between 1938 and 1960: this valuable collection draws back the curtain on the academic education and training given to architects during that period. The drawings are also occasionally accompanied by photographs. Undoubtedly the archival material reveals the teaching technique adopted at the Faculty of Architecture in Rome at that time. The drawings also provide information about the teachers and students attending the faculty during that period as well as the courses that were held there.

Most of the drawings refer to monuments and public and private buildings in Rome: schools, churches, palaces, fountains, bridges and squares as well as other minor buildings, for example rural homes in the Roman countryside. Many are sketches and freehand drawings, but others are drawn to scale using a ruler and set square; different techniques were used including monochrome and colour. Different kinds of interesting calligraphies accompany the drawings.

The archive also houses several photographs of buildings and places in the city, especially black and white photographs. The information provided by these photographs helps to compare not only the old and new façades of these buildings, but also their urban context. This contribution analyses and compares several freehand pencil drawings made during the Freehand Drawing courses with what exists today.

2 About Freehand Drawing

Freehand drawing establishes direct contact between the built object and the person who draws it, especially through one of the five senses: sight. In fact, the minute the draughtsman sees it he begins the study process by observing, assessing and communicating it.

Observation involves identifying the elements of the object and recognising the important ones, i.e., size, ratios between the parts and different building quality. All these elements have to be carefully used as priority items during its graphic portrayal so that reality is conveyed accurately rather than approximately. In fact, the goal is to convey the real identity of the analysed system without being influenced by any personal considerations that can sometimes lead to more artistic images.

[2]Approximately 75% of the drawings have been digitalised. Digitalisation has been entrusted to the one of the technicians in the LIRALAB laboratory of the DSDRA Department, Mr. Roberto Locchi (Photography Lab). Liralab: coordinator Professor Carlo Inglese; Technical Directors, Marco di Giovanni, Paolo Toppi and Lorenzo Monno.

Assessment is the next step; it is a time to choose and discretise the overall architecture and its complexity into a series of subsystems that are independent although they belong to the same family. A decision, a reasoned choice, needs to be taken; this involves deciding what is more important in order to establish a hierarchy of values to be transferred later into the drawing.[3]

It's important to remember that freehand drawing captures reality at a certain moment in time and that the drawing freezes a specific moment in the identity of that reality as we see it in that particular place and at that precise moment.

With the help of the principles and theoretical basis of descriptive geometry and the use of different drawing techniques, norms and conventions of graphic representation, these three steps will produce drawings which may be aesthetically pleasing, but will above all convey information that in time can be interpreted unequivocally and in the same manner by both those who made them and those who view them.

3 Interpretation of an Architectural Drawing

The main goal of this study was to review the history of a drawing: not only analyse the draughtsman's interpretation of the artefact in question, but also try to understand the goal he wished to achieve by observing its graphics. The study also involved examining the calligraphy, the approach to the drawing, its layout, as well as trying to understand the choice of representation methods.

Interpreting a drawing is a complex endeavour; it's better to analyse each aspect as well as the importance and meaning of the drawing separately and then compare them with the overall image. Everything will help to understand the image; this includes what is visible but also invisible, i.e., what the drawing wanted to express. Obviously this is not an exact science, especially when the author is unknown and the drawings were made many years ago. Subjective and objective parameters were used in this study; analysing the latter is more difficult because they are always filtered by one's own personal values. Every sign expresses a meaning and it's important to try and interpret it in a correct, intelligent and reasoned manner.

Multiple variants are part and parcel of this undertaking: history, i.e., the historical period in which it was made, the personality of the author, the graphic technique and another aspect that shouldn't be underestimated: the purpose of the drawing, even if it is not always easy to pinpoint.

The first thing to do is to analyse the subject-matter, taking care to establish the represented architectural type—a public or private building—and also the representation method used to portray it; a perspective sketch, a plan, elevation or axonometric projection. Each representation method has its own codes, structure and rules; correct management of all the above is perhaps one of the aspects that

[3]Carreras (1983).

first catches the eye of an expert and is in fact an undeniable objective value. If the representation method is not geometrically correct it invalidates the importance of the drawing.

Analysis of the graphic document also involves assessing the support on which the drawing has been made and the technique or techniques that have been used: these factors are often interrelated (Bristol board for pencils, tracing paper for Indian ink, etc.).

The actual image also has to be evaluated to understand why that particular viewpoint was chosen, why the draughtsman chose to represent certain parts of the view, and the area filled by the drawing on the piece of paper. This important preliminary step helps to understand the reason why the scene was chosen, a reason that always influences its representation.[4]

The calligraphy of the drawing is influenced by many factors: the school, i.e., the training received by the draughtsman, his personal talents, his flair for representation and also his personal sensitivity and manual skills. I'd like to stress that the latter, certainly the most practical aspect, is absolutely crucial; in fact, the continuity with which one mentally interprets an architectural object and the moment when one draws it is extremely important and crucial when managing the analytical graphic process… just like a surgeon who in the operating theatre needs to continuously practice in order to remain well trained, especially when executing microsurgery. Likewise, whoever draws freehand needs to be taught to interpret and has to practice continuously.[5]

4 Comparing Drawings

Before redrawing some of the views chosen in the former Radaar archive of drawings I decided to check the three sites. In fact I verified in situ the viewpoint chosen by the draughtsmen in order to identify the changes, additions and variations to the site and surrounding space so that I could make comparable drawings. This allowed me to not only control the changes in the area in question, but also confirm how, after so many years, there was no change in the approach to real life drawing by architects working in this disciplinary sector when they wished to understand and convey urban and architectural heritage.

Although there was no written information in the selected drawings, they were in fact made around 194,850 by students attending one of the Courses on Real Life Drawing held at the Faculty of Architecture in Rome. I was able to ascertain the date because the drawings were inside special folders/containers indicating the Course and the academic year when they were executed.

[4]Ching (1990).

[5]Very important is the drawing process.

So I am sure that the drawings I chose were produced by the Roman school during that period; they were executed under the supervision of excellent teachers who, during the early years of the faculty of architecture, were tasked with establishing a scientific and didactic training programme.

It's important to point out that as the person who made the contemporary drawings to compare with the old ones I also attended the same Roman school which has for many years focused on the comprehension of cultural heritage and that now I teach this discipline in the very same faculty of architecture.

To compare these drawings I used the parameters mentioned earlier because this was the most flexible and successful way in which to define each of the aspects in question without eliminating the relationships and links they have in common.

The parameters are: choice of subject-matter; purpose of the drawing; the view; assessment of the representation method; appreciation for the graphic calligraphy; analysis of the graphic technique; the intensity of the signs; the treatment and textures used to represent shadows (Fig. 1b).

The first archival drawing I examined represents the Church of Santa Maria in Aracoeli in Rome. The church stands in privileged position at the top of the Campidoglio Hill just to the left of the famous square designed by Michelangelo. It was easy to find the viewpoint because in the meantime no changes have been made to the area in question. In fact, only the vegetation has changed; it is now much thicker compared to the old drawing which only has a small, difficult-to-define shadow area.

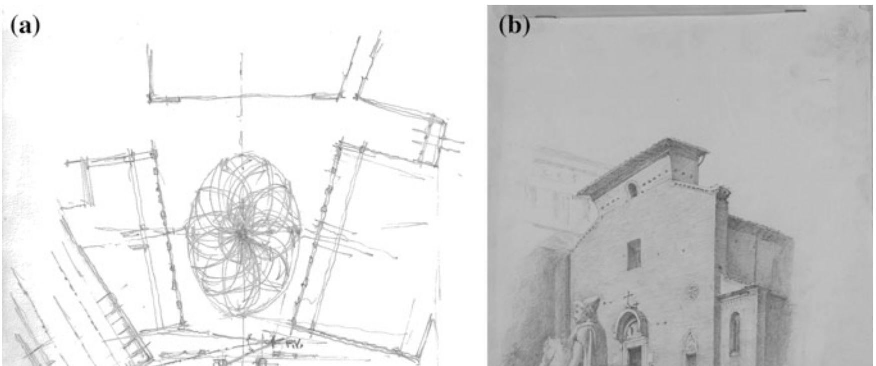

Fig. 1 **a** Plan of Piazza del Campidoglio showing the viewpoint, E. Chiavoni. Rome 2015. **b** Archival drawing, Church of Santa Maria in Aracoeli, Rome, c. 1948

The marble statue in the foreground acts as a reference for the layout of the drawing; it provides momentum and highlights the graphic composition because it is the lightest part of the drawing.

The pencil marks of the shadows on the building and the shadows on the ground was achieved using rather regular, dense textures that slope in a precise direction. Even the wall pattern on the church façade was created using a thin pattern of lines that follow the direction and inclination of the perspective. The faint background with the monument in Piazza Venezia was drawn using very light pencil strokes; it is almost certainly instrumentally exploited to highlight the plane of the church façade. This choice was probably made by the draughtsman to emphasise the momentum the church conveys to the onlooker. The viewpoint used to create the perspective coincides with the current corner of the step in front of Palazzo dei Conservatori, to the right of Piazza del Campidoglio; from this viewpoint it's impossible to see the base of the church (Figs. 1a, 2 and 3).

The second old drawing depicts a corner of Piazza di San Giovanni in Laterano in Rome. This is a particularly important religious area with a large, empty space/square that acts as a base for the imposing, important buildings. Today heavy traffic passes through the square at all times of the day and night and the historical

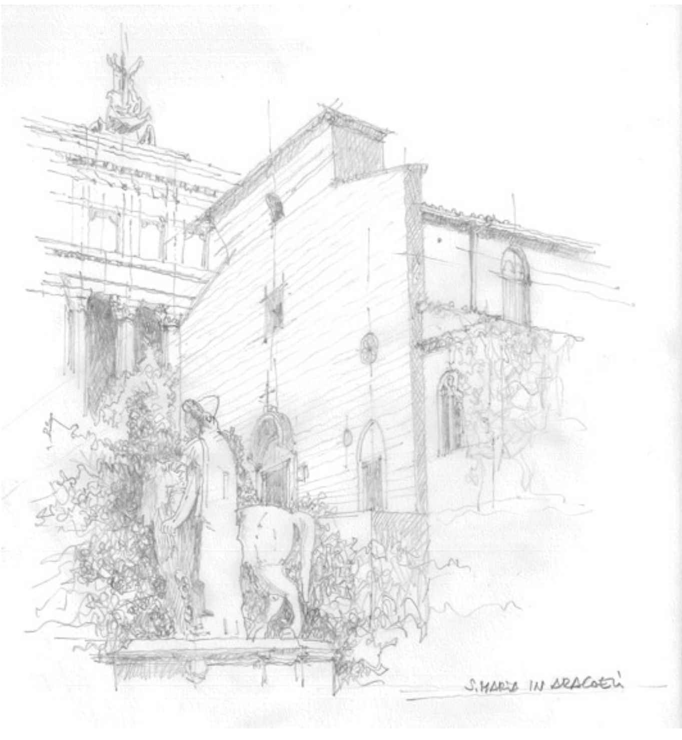

Fig. 2 Perspective sketch of the Church of Santa Maria in Aracoeli, E. Chiavoni, Rome 2015

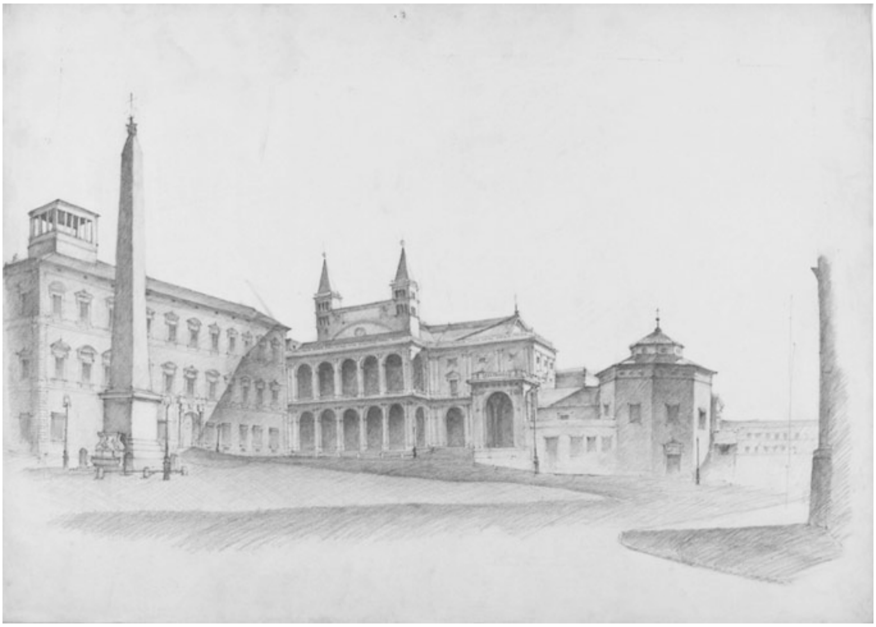

Fig. 3 Archival drawing, Piazza di San Giovanni in Laterano, Rome, c.1950

buildings act as a frame around this flow of cars, tourist buses and buses. The contemporary drawing reveals the changes that have taken place, especially to the right of the image; in fact, a building has been added to the right of the Baptistery as well as other little changes (Fig. 4).

The viewpoint is in the right-hand corner of the square, opposite the Baptistery. All the traffic passing through the square made it difficult to draw from this viewpoint because it was impossible to get a full view: yet another reason why the base of the building is not well defined. The façade in the historical, archival drawing is completely in shadow. The shadows have a fairly regular texture; they spread across the area in front of the square and all go in the same direction and with the same inclination. To emphasise the architectural elements that make the buildings in the square recognisable, I decided not to include shadows in my contemporary freehand drawing but did hatch, with spontaneous textures, only a few parts at the rear compared to the main planes of the buildings.

The third urban space was the square in front of the Trevi Fountain; my drawing of the square was problematical due to a worksite set up to maintain and restore the fountain.

The fountain was designed by the architect Nicola Salvi in 1735. This masterpiece is the biggest fountain of the Late Baroque period in Rome and is considered the most famous fountain in the world. The fountain rests against the rear façade of Palazzo Poli and was built during the construction the Vergine Aqueduct

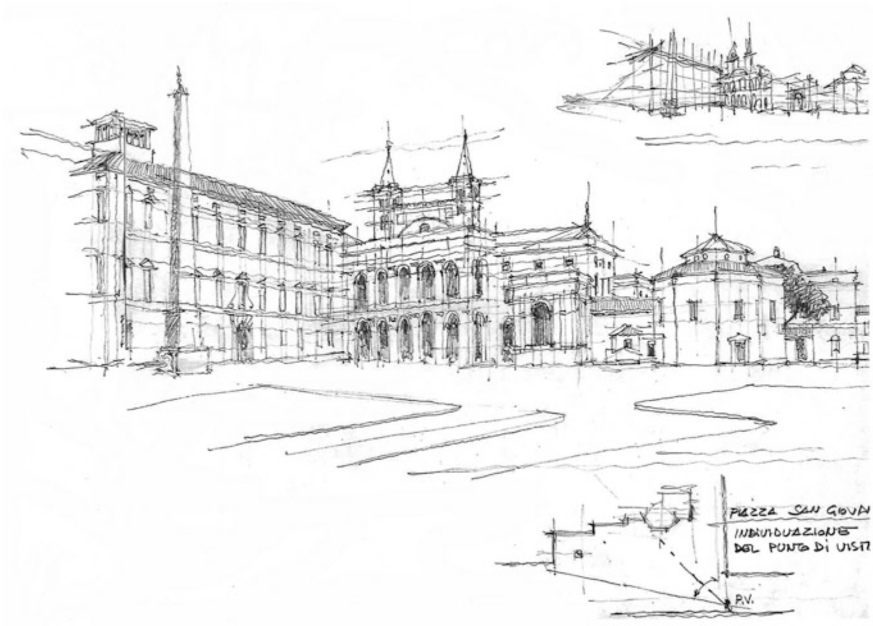

Fig. 4 Real life drawing of Piazza di San Giovanni in Laterano and plan showing the viewpoint, E. Chiavoni, Rome 2015

commissioned by Emperor Augustus to bring running water to the Pantheon and its baths (Fig. 5).

Comparison with my contemporary drawing revealed several small changes in the windows and doors on the façades of the residential building to the left of the fountain.

It was impossible to describe much of this dense urban area, and in fact the full view was not visible because at the time it was hidden from view by the panels around the worksite.

The shadows (similar to the ones in the drawing of the church of St. John Lateran) were another element I compared against the old drawing. In this case the shadows were used above all to contrast the lighter tones. In all the drawings I interpreted I also critically assessed the calligraphy of the pencil marks since they are unquestionably characteristic of the school and type of training imparted during that period. The undisputed importance of these valuable drawings is represented by their remarkable graphic elegance, control of proportions and representation methods. By retracing the way in which these successful documents were made after so many years I once again verified that the analysis performed using real life drawings is always crucial, not only to understand architecture and the city, but also as an essential ingredient of any education and training programme (Figs. 6 and 7).

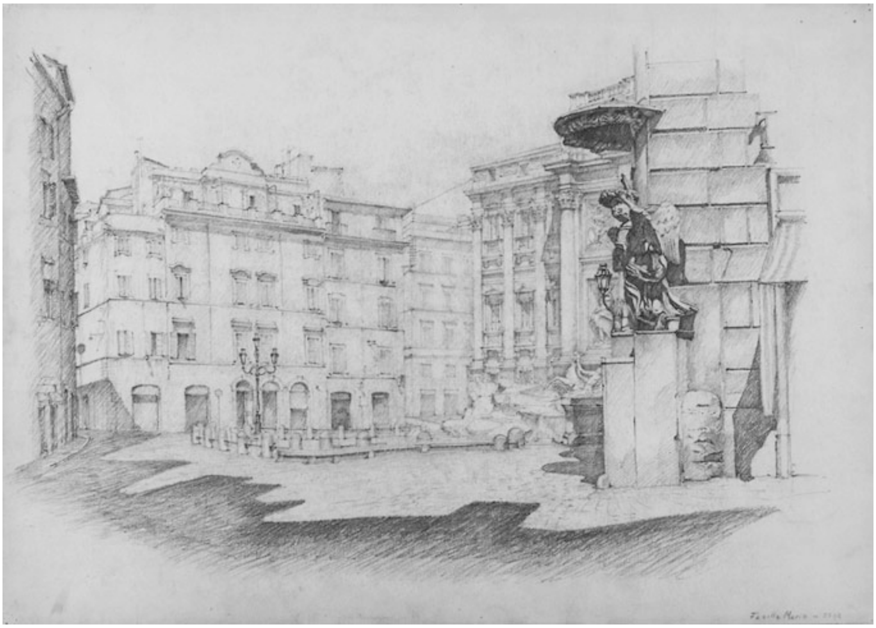

Fig. 5 Archival drawing, Piazza Fontana di Trevi, Rome 1950

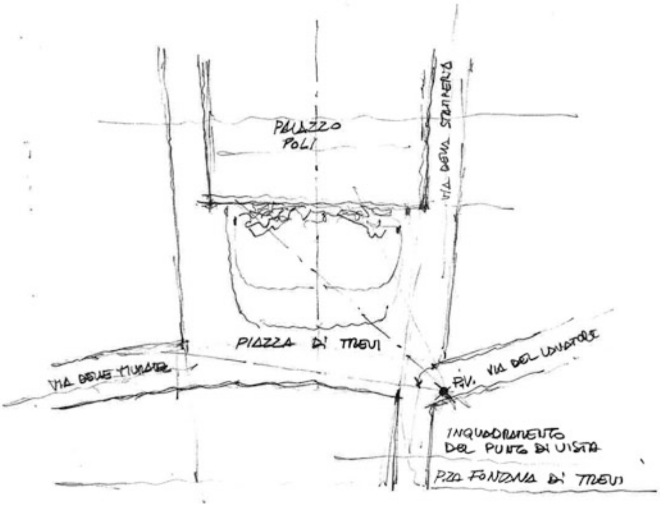

Fig. 6 Real life drawing of Piazza Fontana di Trevi, E. Chiavoni, 2015

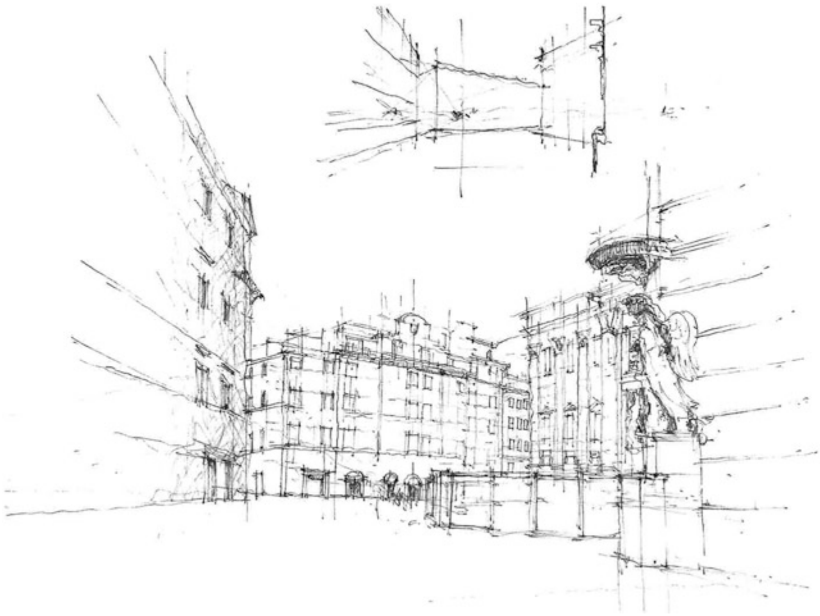

Fig. 7 Plan of the square in front of the Trevi Fountain showing the viewpoint, E. Chiavoni, Rome 2015

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Graphical Strategies for a New Swedish Architecture: Asplund and the Industrial Arts Exhibition Design in 1930

Víctor A. Lafuente Sánchez and Daniel López Bragado

Abstract Throughout the twenties, Gunnar Asplund, being unaware of any fashion or trend, had been one of the leading figures of Nordic Classicism in Sweden. However in 1930, his style would radicalize, influenced by the tenets of international style and functionalism. The Stockholm Exhibition 1930, whose design he assumed, needed to show the new situation caused by the changes in the industry and the arts within daily life and especially in the field of housing. His ambitious architectural proposal made the exhibition one of the most important in the history of architecture in Stockholm, establishing functionalism as the predominant style in Sweden.

Keywords G. Asplund · S. Lewerentz · Drawing of modernity

This Communication is part of a research on the architectural drawing in Modernity, which coincides with one of the subjects taught in the Master of Research in Architecture from the School of Architecture of Valladolid, which gives access to new European Higher Education Area Doctoral studies.

1 The Background of the New Functionalism

Throughout the twenties, Gunnar Asplund, oblivious to any fashion or trend, had been one of the leading figures of Nordic Classicism in Sweden. However, from 1930, his style would take a radical turn, largely influenced by the tenets of international style and functionalism. The text (Asplund 1928) in which he

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Fig. 1 Covert of text in wich Gunnar Asplund explained his Library of Stockholm, published in Byggmastaren in 1928

explained his Library Stockholm, published in Byggmästaren in 1928 (Fig. 1), talks almost exclusively about the functional aspects of the project, without showing greater enthusiasm on formalistic or aesthetic issues.

Ahren (1897–1977) was not a mere upstart student trying to overthrow his master, but a leading figure of the next generation, and he had a new vision of architecture that began to emerge. About to become a leading modernist in Swedish panorama, he became editor of Byggmästaren (Ahrén 1928) between 1929 and 1932, and after he was Chief of the Planning Office of the City of Gothenburg. Prior to that, he had already begun in the New Classicism, but in 1928 moved in that way thanks to their enthusiastic participation in the events of Central European architecture. Since 1925 he had admired the Pavilion de l'Esprit Nouveau in the Exhibition of Paris, which led him to publish in 1926 a controversial article on the Swiss master entitled "Vers une Architecture". His indisputable admiration made him the main driver of Le Corbusier's visit to Stockholm in 1928 to give a lecture.

Uno Ahren was closely related to other important architect closer to the age of Asplund, Sven Markelius (1889–1972). Ahren and Markeluis collaborated in the KTH students building in Stockholm (1930), whose competition they had won in 1928, being Asplund one of the components of the jury. This was one of the first works of the new functionalism, and it was running in parallel with a work that Markelius had begun even a little earlier, the Helsingborg Concert Hall (1926–1932), which would later be dubbed the first truly monumental functionalist building in Sweden. In fact, the winning project of the competition in 1926 was eminently classical and remarkably debtor of Asplund's architecture with elements of the Stockholm Library on its exterior design and others of the Skandia Cinema in the inside resolution. However, at the time of its completion in 1932, he had already evolved into a much less committed modernist composition from his contemporaries. Markelius had also contacts in Central Europe, and in the summer of 1927, he would make a trip through France, Germany and Holland, visiting the Weissenhof Exhibition in Stuttgart and the Bauhaus in Dessau. In the latter he met Walter Groupius and becoming friends, and Gropius would visit Stockholm later on several occasions, residing at Markelius' home. Through Gropius, he became involved with CIAM, becoming the delegate of Sweden since 1929.

2 The Beginnings of the Stockholm Exhibition

Swedish Society for Crafts and Design, which launched the exhibition, was founded in 1845, taking responsibility of organizing several exhibitions in the late nineteenth century. In 1915 it would be reorganized, recognizing the need of focusing, on the one side, in the challenge of the machine, and on the other, in the acceptance of manufactured products derived from this revolutionary innovation. This question, which had already caused fierce debates in the Deutsche Werkbund (German equivalent society), divided its members into two different sides. The most significant sector was modernizers, led by the art historian Gregor Paulsson, who defended the need of a greater integration in the field of design of these new products. He became director of the Society in 1920, three years after the successful Home Exhibition held at Liljevalch Art Gallery in Stockholm in 1917, which included a kitchen designed by Asplund. This exhibition, and the section of Sweden in the Paris Exhibition of 1925, showed the way for Stockholm Exhibition. Aware of the Weissenhof Exhibition organized by the Deutsche Werkbund in Stuttgart, Paulsson conceived the idea of an ambitious show, proposing it to his council in June 1927, where it was received with enthusiasm; this led to him being appointed as a member of the working committee, along with Gunnar Asplund and Hugo Lagerstrom. The Swedish State and the City of Stockholm guaranteed their support, as several benefactors did, and soon a number of committees were established to develope the enormous task. Within days, Paulsson was appointed Director, and Asplund became the exhibition chief architect.

After selecting the place and approving the program, in June 1928 Asplund was commissioned to develop a project that would show the new situation created by changes in the industry and the arts in everyday life and especially in the field of housing. Primarily designed to focus on Swedish products, they were classified into three sections: home, household products, and the street. His ambitious architectural proposal made it one of the most important in Stockholm architecture history, and it set the functionalism as the predominant style in Sweden. The surprising stylistic choice in the exhibition supposed a defiantly modern architecture for Swedish society of that time, and then, it was criticized as a break in Asplund's career. Many people could not understand that this master of the Swedish architecture became the author of a foreign configuration so far from their native traditions, more known by the general public. However, in the layout and the management of open spaces in relation to buildings, Asplund tried to build a less consistent with the modern architecture programs urban space.

Although none of the primitive drawings have survived, he took its inspiration from the forces of the place. As reported by Paulsson in his autobiography, buildings would acquire an essentially classical form, as in Snellman House. From the beginning, although the ideas developed in the successive proposed buildings would persist and influence the form of housing in Sweden for many years, the buildings were designed from their temporary nature and, therefore, conceived with a clear ephemeral will. So he proposed the use of laminated wood arches in a series of round huts with glazed ends (Fig. 2), which was a major shift towards an architectural system based on the materials an its constructive nature. The sketch of the site, made by Asplund, shows from the beginning strokes that can be appreciated in the final design outcome, the interesting contribution of of captive balloons, as an early indication of the festive atmosphere which he sought to obtain. This version was presented in August 1928, but the idea of the narrow aisles did not like too much, so Asplund and Paulsson were forced to take a trip around Europe, seeking inspiration for the ultimate solution in other exhibitions of the time.

In late 1928, Asplund had his proposal revised, corrected and developed in a plan that the Committee could assume and support with enthusiasm. Ivar Tengborn,

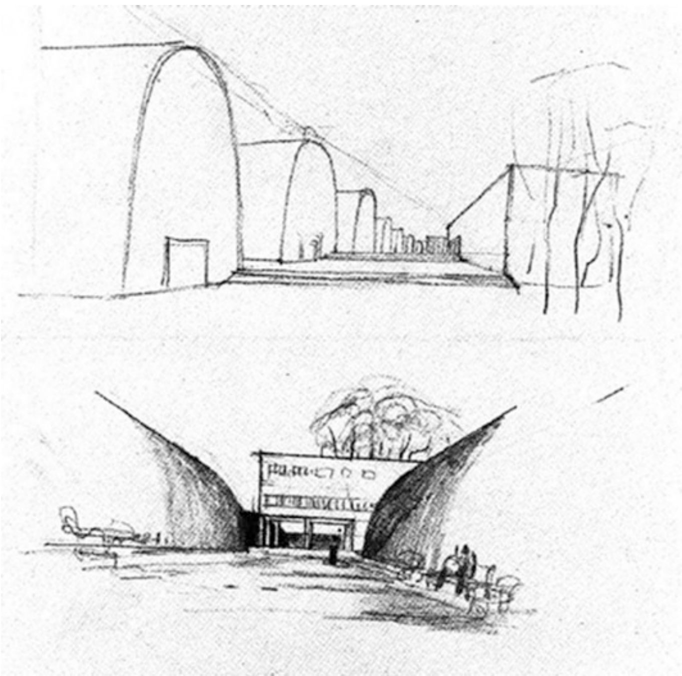

Fig. 2 Previous version of Stockholm Exhibition of 1930. Gunnar Asplund (1928)

Asplund's master and pioneer of classical revival, who was a member of the Committee, congratulated his pupil because of the new architectural language of open porches, available tactfully in an exquisite balance between the New Classicism and functionalism rupture wave. It is worth examining in some detail this provisional version, despite lacking the final design of the buildings, which are suggested in crude and neutral forms. However, all the important decisions about the site, the implementation of the different buildings and the spatial relationships between different elements had been taken.

3 Preliminary Design

Although the exhibition was shown in a neglected area at the east of the city, the place was potentially beautiful and full of possibilities. It was oriented to the south and across the Djurgårdsbrunnsviken lagoon, facing the Djurgården hill, where Skansen is located. As a crown property, because it was, in its day, part of the King's Deer Garden, it was engaged to military and exercise camps before the 1925 economic cutbacks barracks, leaving them abandoned. The dense urban fabric stops suddenly in the Djurgard bridge, leaving the Nobel Park at the East. This small complex of rich villas planned around the English Church, moved there in 1913, includes the Villa Geber of Östberg and is, today, the diplomatic quarter. Access to the exhibition was established, from the beginning, adjacent to this district, with a public transport stop and a pier to reach visitors who use the nautical transport. Asplund loved the possibilities of water, and he tried to make use of most of the northern shore of the lagoon, adding a temporary pedestrian bridge where the lake narrows, so the exhibition leisure area could take the other side. According to Paulsson, undocumented first version also introduced the excavation of an angled channel that helped to define the central square; although it was ultimately too expensive, part of the idea persisted in the form of shallow pond projected at that point.

The drawing of the preliminary design (Fig. 3) shows that Asplund, from the beginning, seems to have conceived his project as a longitudinal travel, formalizing itself as a street which he baptized as "Corso" in memory of his travels to Italy. As López Peláez stated (2002), "an important clue of the project to Asplund is to name elements in his creative process, as a key action, because this sound gives them real content, even before taking the decision to define their specific configuration".

This project linearity would begin at the transport arrival point, with an open arch at the edge of the lagoon, which greets visitors, in a clearly evocative action. The first group of pavilions was located on the left side of the road, parallel to the lagoon, and at the point where it diverged, he took the planetary circular form, in a clever geometric strategy, to use it as a pivot, also turning the guideline of the street. He even created a small alley in the planetary shaft driving through small exhibitions and booths among existing trees along the proposed restaurant at the lagoon shore. Changing the angle at the planetarium, the "Corso" continued parallel to the

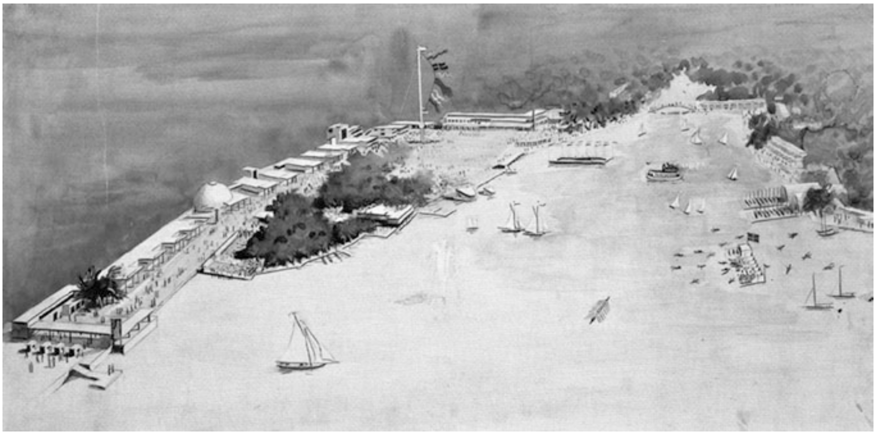

Fig. 3 Drawing of the preliminary version of Exhibition

shore, which was extended and rectified by a built “ad hoc” boardwalk. The existing deep space on the north bank resulted in longer pavilions and other buildings in the back, that intended to provide a depth urban sought illusion. The large space between the Corso and the lagoon would become the great square Festival, with a large open-air theater.

Although the hitherto mentioned is only a simple reading of the project plan, the design was enriched, moreover, with a section reading. But we will focus on a more concrete analysis of the graphic strategy followed to present the idea. Both the preserved drawing of the exhibition preliminary design and the rest of perspectives and views about the finally adopted solution that were later realized, were mainly made by Rudolf Persson. Commissioned by Asplund, he made them in gouache, with a certain air to the propaganda posters. This series of drawings (Fig. 4) shows the festive and cheerful nature of the exhibition, in order, intentional, to show the softer side of modern architecture.

Rudolf Persson was a visual artist born in 1899 in Örebro County, and died in 1975. He studied at the School of Art and Design and the Academy of Art in Stockholm, expanding his artistic learning in Germany, France and Italy. Expert in urban landscapes, still lifes and natural environments, he shows a characteristic lightness in his style, which seems to introduce air into something as static as painting, thanks to his masterful use of light colors, especially blue. It has clear influences of Raoul Dufy (1877–1953) both in style and, above all, in its theme. Dufy loved sailing boats, as Swedish love the sea, and acclimated them in French Riviera bright views. But he was also a festive lover, devoting much of his work to reflect musical events, fancy celebrations, horse racing and other outdoor activities in hot spots. Part of this whole nautical and festive world is inherited by Persson and expressed in exhibition suggestive views.

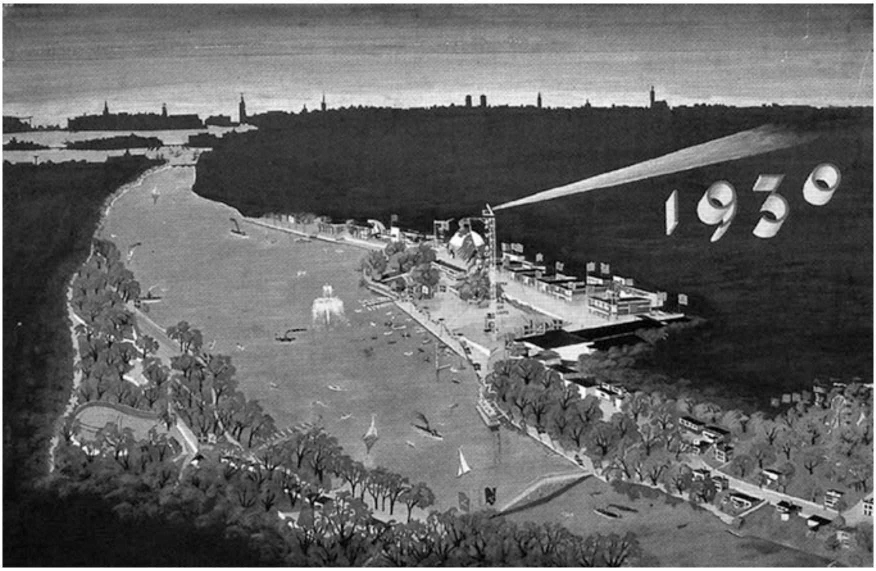

Fig. 4 Drawing of the preliminary version of Exhibition

4 Final Version

The preliminary plan shows the basically repetitive layout of pavilion structures, much better than the final version paintings. Most of them were designed eventually to open at the front, facing the exhibition and the lagoon. While in preliminary version the entry consisted of a more modest plane porch, at the end it was lifted up two levels through a flat roof on thin metal pillars, extending longitudinally to the water. Administrative spaces and reception were located under the left side. Just then, flanking the Corso, and toward the Planetarium, Transport Hall was located. But especially notable were, in the final version, the Paradise Restaurant and Pavilion Entry (Fig. 5), projected into the absolute forefront with their steel structure and large glazed surfaces, dramatically lit at night, as we can see in a Rudolf Persson new drawing.

The architectural proposals that Swedish Sven Markelius, Paul Hedqvist, Nils Ahrbom, Helge Zimdal and Uno Åhrén showed in the exhibition offered new housing alternatives, bright and hygienic apartments, with wide space for all family members. Many of them would sign the following year the manifesto “Acceptera”, including the slogan of the exhibition itself, would point the need for a functionalist orientation in the production of housing and consumer goods. Pavilions, light like machines mademetaphorical games towards exhibition, adopting in its architecture transport and marine forms. But, for Asplund, life is brought in his exhibition by people who walk, events that happen and relationships that last. The surprising fireworks have are as important as pavilions.

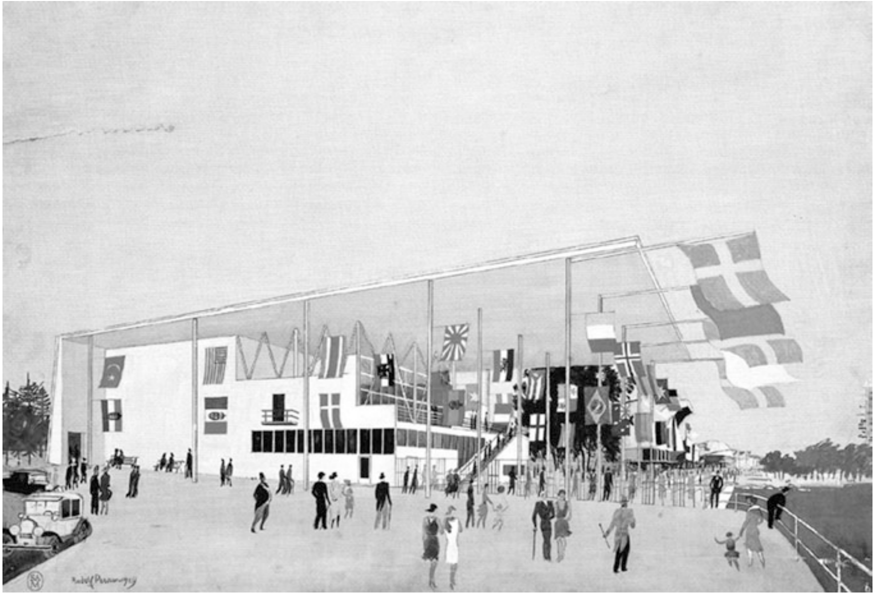

Fig. 5 Drawing of the final version of Exhibition

As Alvar Aalto said, and we gather here in conclusion, "the pretended influential social manifestation of the Stockholm Exhibition was covered with an architectural language of pure and spontaneous joy. There is a festive refinement, but also a children need to reach all. Asplund's architecture transcends all boundaries. The purpose is holding without prejudice, both in the architectural sense as elsewhere. It is not just a composition of stone, glass and steel, as enemies of functionalism might think, but in houses, flags, reflectors, flowers, fireworks, happy people and clean linens".

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The Architect of the Future According to Rem Koolhaas. Key Points for Its Necessary Adaptation and Pedagogical Conclusions

Jorge Losada Quintas and Lola Rodríguez Díaz

> "*It is not the strongest of the species that survives nor the most intelligent.*
> *It is the one that is most adaptable to change.*"
> *On the origin of species*, Charles Darwin

Abstract Nowadays, Rem Koolhaas is considered one of the leading architects. However, the Dutch architect overflows the profile of the so-called 'starchitect' that accumulates pages in magazines. His prolix theoretical production has also played a central role in his reception since he wrote Delirious New York in 1978. For these reasons, one could say that Koolhaas captains this generation of architects and the truth is that he has emerged as a figure of required reading. Therefore, it seems appropriate to determine its position on the role of the architect and infer lines of work applicable to education.

Keywords Rem Koolhaas · Architecture education · Role of the architect

Nowadays, Rem Koolhaas is considered one of the leading architects. However, the Dutch architect overflows the profile of the so-called 'starchitect' that accumulates pages in magazines. His prolix theoretical production has also played a central role in his reception since he wrote *Delirious New York* in 1978. For these reasons, one could say that Koolhaas captains this generation of architects. And the truth is that he has emerged as a figure of required reading. Therefore, it seems appropriate to determine its position on the role of the architect and infer lines of work applicable to education.

Koolhaas is not an architect of consensus. If there are architects in such category. His work and judgments do not leave indifferent and he has as many followers as detractors. However, under the cloak of provocation and a certain messianism

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related to Le Corbusier, there are lucid reflections following a brilliant diagnosis. His recognized fascination for reality has not clouded his gaze and he strongly advocates the transformation of the architect. And when he does, despite the seriousness of the issue, he isn't moved by the anxiety that seems to have installed in our circle:

> And that means I'm not particularly harsh or pessimistic about a profession that actually compete understand the formation of cities, analyze them and transform them, though I'm self-convinced that urbanism as we today cannot stand. Their inability shown in many ways the most important of which can be the difference between the idea that professionals have of their own role and the current situation, with a totally opposite logic market and leaves no this kind of concerns (Chaslin 2002, 83: 25).

Obviously, in a short article it is impossible to dissect the work of one of the most successful and widely published architects in recent decades. However, in order to draw a portrait of his thinking on the role of the architect, we can choose representative samples of their work in different areas and, with these strokes, try to draw operational conclusions.

First, we should analyze the organization of their own business. Since its founding in 1975, OMA was born with the will to integrate different disciplines to address the whole game board with guarantees. Together with the architects Rem Koolhaas and Elia Zhengelis, the initial core was completed with artists Madelon Vriesendorp and Zoe Zenghelis. In fact, the letters stand for Office for Metropolitan Architecture. A designation that prevents the corset of the traditional 'studio' in analogy to the famous 'Factory' of Andy Warhol. Both of them have done that in clear reference to the prevailing market but with different approaches. If the proposal had faded with time and the withdrawal of some of the other founders, Koolhaas established the Architectural Media Office in 1998. This second office came to include all activities that are not stuck to the construction of spaces: exhibition design, 'branding' advertising design or the publishing business, among others. Its creation responded to the need to adapt to a new reality. In other words, the OMA/AMO duo was running in the early twenty-first century as a design firm capable of intervening at all levels in a complex market that demands cross creators capable of generating products of various natures.

1 Work

Of his many works, if we want to analyze those where the traditional profile of the architect is in crisis, the work developed for Prada for the past fifteen years is soon highlighted. It is convenient to trace briefly the root of the shopping space. Since the advent of the consumer society, the stores have been a collaborative space, a space where many disciplines are constantly being combined. Juan Daniel Fullaondo defined it in these terms:

> A store, a shop, is in a sense in a fairly committed crossroad: there is some architecture, a bit of art restoration, a little decoration, a bit of industrial design and a little urban design; this is a very complex problem. […] I thought of having read a very 'd'Orsian' outlining for this crossroad. It was something like this: 'decorator is moved by appearances, the architect by realities and the set designer by illusions (Fullaondo 1968, 111: 21).

The second part of this quote attended to a traditional division of disciplines and some commissions accepted this distribution of tasks. However, during the last fifty years the world has changed radically. Consequently, the division has become obsolete in both, categories and skills needed. In fact, Koolhaas's success resides precisely in this point: its ability to handle complex situations, and coordinate appearances and illusions; to move in an ambiguous space between various disciplines.

The fruitful relationship with Prada began in 2000 and what started as a redesign of the shops, has led to ambiguous and unexpected products that transgress the traditional boundaries of the architectural discipline. This piece of information is particularly significant when you realize that fashion is an area in which the forms and design are consumed voraciously. The Prada Epicenters (New York and Los Angeles) were created from seasonality, realizing that the market demands constant change to a company of this kind. The ephemeral nature and mutability of Koolhaas's proposals—of which could be said to have an own philosophy of work and a certain detachment from their forms—are its biggest asset. An architecture that avoids the durability and, although it is a viral phenomenon, does not brag about itself. The stores are a stage, a show that supports or constantly re-build the brand identity. The store become frameworks and demands hundreds of events that are greedily consumed.

Instead of falling into exclusive architects' talks, the Dutch try to understand the customer's language and respond with a deep reflection based on their language. You could say that his firm offers a sort of parallel research project (which has been published on many occasions) and without it the project does not exist. This kind of investigation frames and generates an intellectual context for the architectural proposal. So, there is a narrative based on something external that on many occasions, relies on architectural references that are consciously relegated to the background to meet the customer. Sometimes the formal mechanisms are so willingly basic, bordering on the naive, that many feel cheated by an architecture whose origins they don't understand. And it could be, as Ortega warned about art, that anger and irritation follows to a position of inferiority.

The entrance of the Dutch architect in Prada happened at a time when the Italian firm was going through a crisis caused, ironically, by its commercial success. After a conceptual redefinition, OMA tackled the invention of a coherent program for the Prada Epicenter. The solution for the new headquarters could not consist of a mere enlargement. On the contrary, the new Epicenter should provide brand new and engaging program. Koolhaas's approach seems to follow what Warhol once predicted "Someday, all department stores will become museums, and all museums will become department stores." If shopping space, as predicted by the artist, had devoured all sorts of programs, it seems fair enough that a space of sales offered an experience far from the typical and banal consumption.

Consequently, luxury should bring its users to an alternative space where they could forget their condition of mere consumers. The theoretical proposal crystalized in the following types: The gallery, the street, the stage, the park, the generic Prada, the wallpaper, the library, the gallery of prototypes, the showroom, the file, the laboratory, the clinic or pharmacy. The experience of the visitor—no longer a consumer—would leave the commercial sphere and would approach to the cultural sphere. Arguably here Koolhaas put into practice what they stated in S, M, L, XL as proposed "A maximum of program and a minimum of Architecture" (Koolhaas and Mau 1995, 199). A position that led him inevitably to a vague and open architecture, where the relationship between enclosure and form is immersed in uncertainty. The author himself confirms this negation: "Where there is nothing, everything is possible; where there is architecture nothing can happen" (Koolhaas and Mau 1995, 199). Is this a waiver of architecture? What is architecture if we subtract its poetic and heroic dimensions?

These stores can be understood as transmitters, eager for content. They are critical nodes in Prada's extensive network and they reach the audience through multiple channels. We know products, events, and proposals via Instagram, Facebook, Twitter or YouTube a long time before we visit the physical space. Content, on the contrary, refers to formal aspects and varies rapidly. In other words, Koolhaas plots versatile scenarios then occupied by different actors. Together, they create a complex and contradictory formal universe. In this game of mirrors between museums and shops, it is difficult to resolve how these commissions became art. Yet Koolhaas denies its artistic status and argues that his proposals are sticked to the architect role. Moneo elaborates that the Dutch architect "has always wanted to present his work as the result of a cooperative effort and solidarity as an alternative to the solitary work of the artist" (Moneo 2004, 309). So, we cannot help noticing that the identity of Koolhaas, like Prada, also incurs deliberately in contradiction.[1] Maybe that's the reason why Koolhaas dares to project himself on the figures of Le Corbusier or Mies. It could be his ego emerging as fine irony. The distorted Barcelona Pavilion for the Milan Triennale, the text "Mies Takes" or Villa dall'Ava come to our minds quickly.

Similarly, the Prada Transformer in Seoul (2008) also boasted of this versatility. The project combined four different programs (runway, showroom, cinema and museum) in a single pavilion and it consisted of a tetrahedron wrapped in a translucent fabric that allowed the activation of a different program by rotating it. The project root sinks into the culture of spectacle since to change the use it was necessary to raise it with cranes and turn it in the air. Here, the architect offered its position on disciplinary boundaries:

[1]We found a revealing statement in this regard by the own Koolhaas: "There is an enormous, deliberate, and—I think—healthy discrepancy between what I write and what I do". Heron, Katrina: 'From Bauhaus to Koolhaas' en Wired no 4.07, julio de 1996.

> As you know, there are currently a lot of interaction between art and fashion these days, between art and architecture and between architecture and fashion. We have been working for Prada since two thousand and I think that we are a symbol of this collaboration. Basically what is happening is that disciplines that used to be separate are becoming a single mix. This project responds to these disciplines, but from a strictly architectural point of view.[2]

These lines define particularly well Koolhaas's work and its place in the landscape of architecture.

In the fruitful relationship between Koolhaas and Prada also highlights the catwalk design, especially those installed on the warehouse that the company owns in via Fogazzaro, Milan. This industrial space recovered works as a big scenario that can be configured again and again just adding context, reference and meaning to collections. As in the Epicenter, catwalk design combines architecture, interior design, graphic design, lighting, audiovisual, illustration, music and, of course, fashion. The basic aim is to accentuate the perception of the show and help to understand the proposed universe. However, the fief of Koolhaas in the transalpine firm covers the website of Prada, the technology In Store, the headquarters of the Fondazione Prada, curating exhibitions and even audiovisual material. This point is particularly illuminating and helps to understand the business strategy and the attitude of the designer to these commissions.

Prada diversifies its advertising effort in all areas, including in the audiovisual and generates a multifaceted identity, which complexity borders on the contradictory. Carefully cultivates a sophisticated ambiguity. First, we distinguish traditional ads where collections are highlighted with an aestheticized universe related to the photo essay. Secondly, the firm has produced short films in which the sale of the product is secondary but reinforce the aura of the company, as Roman Polanski or Wes Anderson shorts. Finally, to complete an identity whose complexity can be tested on the YouTube channel of the brand, AMO has created the Real Fantasies. The name is a statement of intent. "Real Fantasies" continue the fascination of Delirious New York, supported by the culture of congestion and overlays a world whose order is not ambitioned. The videos show the search for inspiration in a stark reality, fleeing the romance and reveal how Koolhaas's attitude towards architecture has been serving Prada. In Real Fantasies abound architectural references as backgrounds for an intriguing show that there is no narrative but a haunting ambiguity. Maybe is the best work in the emergence of imaginary Koolhaas is seen in the Prada universe, which allows and welcomes you to its ambiguous nature voluntarily. The Dutch thus closes a circle that began in his youth and stresses the benefits of transdisciplinary. The boundaries do not care as much as the ability to communicate. This is also recognized Rafael Moneo when speaking of Koolhaas but not of Prada says: "static framework that used to occur architecture no longer makes sense, and the architect has to explore new ways, being perhaps the film the medium more in keeping with our time and our culture" (Moneo 2004, 308).

[2]Prada Youtube cannel: http://www.youtube.com/watch?v=ASRq2DKdQpI.

2 Theory and Opinion

When Koolhaas started working for Prada he had already achieved international recognition. Perhaps, the Pritzker Award (2000) was which attracted the attention of Italian giant. However, there is also the possibility that it was his theoretical work, as neat as a stranger in the world of starchitects which earned him the order by the consonance of ideas. In Delirious New York (1978) a young Koolhaas amazed the world with a fresh eye on unusual subjects against architecture. Reality and its contradictions were the object of admiration and criticism. The culture of Manhattan's congestion and naturalness detected in the US city with that interior and exterior offset are some of the concepts that gravitated his speech. Koolhaas's fascination for the metropolis and its complexity felt here early.

As director of the research group *Project on the city* at Harvard, Koolhaas proposed approach forces operating in the contemporary city. In *Mutations*, first of the volumes derived from this work, 'shopping' was identified as one of the key elements in the evolution of cities in the late Twentieth century. The second volume, subtitled 'Harvard Design Guide to Shopping', focused exclusively on this phenomenon and started with a categorical and similar to what Boris Groys said at *La mercantilización del arte*: "The shopping is undoubtedly the ultimate way is public activity" (Koolhaas 2001). This text provoked a strong reaction in the vicinity discipline. However, we should clarify that, far from issuing a judgment call, Koolhaas was limited to an analysis of the status quo.

In analyzing Koolhaas, Moneo argues that the many perceptible realities, Dutch chooses a "made under pressure from the economy and subject to the forces of unbridled capitalism" (Moneo 2004, 309). Judging from this perspective despises architectural culture because this is disconnect and neglect. But, have we not suffered the extent to which architects are subject to the laws of the market? Would not it be better if we understand the keys to a perspective that clearly seems universal? Taking the pulse of reality should help us overcome a union thought that while pursuing quality, also wasting our proposals. Perhaps if we were to accept that the city, and space, beyond our control, capacity and probably also our vision; maybe then, freed from excessive load, we could adapt better.

Just as in his books, the Venice Biennale was a public and participatory reflection. Rem Koolhaas tries to expose "his" history of architecture in opposition to alternative-historical epic of 'High Architecture'-narratives. This approach seems particularly appropriate to the schools of architecture, did not really understand the ravings would get us a better education? Evaluate the built in quantitative terms is to architecture what the 'big data' to the business world. It should help us get a more accurate idea of the forces at work in our environment. Redundantly, one could also argue that exceptional works—those passing the canonical stories, with great customers and gifted designers—distort our perception of ourselves. Koolhaas stated in similar terms when he says: "My job is deliberately not utopian" and continues: "My job is positive about modernization but critical of modernism understood as an artistic movement" (Koolhaas 1996).

Finally, it would highlight his last major public exhibition as curator of the Venice Biennale of Architecture in 2014 and titled Elements of Architecture in what appears a reference to the *beaux art* education. The exhibition, like much of his work, pointing to the obsolescence of traditional profile of the architect but at the time, noted improvement ways. It was an atypical Venice Biennale in which he spoke of "architecture without architects" and that many blamed on an excessive ego. We could say that the Biennial was also some pedagogical purpose. The author makes this explicit when he says:

> These radical changes (technological and mechanical) have been recorded in our technical half of the brain, but scarcely been noticed in the deep core architecture. Discipline suffers from schizophrenia, pivoting between architecture as art and construction as an instrument of modernization. This schizophrenia involves our role as 'givers of form' is increasingly precarious and empty, from the moment that there is a challenge to create a master on the mechanics course similar to our control over the material part. The reputation of architects and the expectations generated are based primarily on their supposed uniqueness. However, what we do today is to join other elements designed, mass-produced and offered in catalogs internet accessible to everyone (Koolhaas 2014).

The harshness and finality of judgments Koolhaas borders on the cynical or naive. However, it can be said that their texts are similar to those of Georges Perec in *Especies de Espacios*. Definitely, to difficult circumstances like those outlined, there are only two positions: the passionate revolt against the elements or the acceptance of the world as it is. This last what to describe prodigiously Herman Hesse: "Instead of narrowing your world, to simplify your soul you will have to accommodate increasing world will have to accept in the end the whole world in your soul painfully widened, to reach perhaps someday finally break" (Hesse 1997, 75). In the work of Koolhaas, this fascination with reality becomes part of the poetic core. The apparent aseptic his look also has some flair.

3 Practical Application

Once exposed the concerns of the Dutch architect try to draw conclusions for teaching. However, it should be noted that these are purely speculative and fruit of a personal interpretation of the keys to its production. Clarified this point, we can say that Koolhaas suggests overcome the epic of our discipline. Therefore, it is crucial not to miss in unique concerns and strive to speak the language of customers and not pretend that they understand ours. His proposal, not devoid of radicalism that demands authorship, is considered less architects and accept our position—humble and limited—quite in the order of construction. Putting understanding of customer problems on their own terms the formalization process requires a constant willingness and deprives us of our apparent control of the situation. The implementation of this work culture should be encouraged since the Studio signatures.

Moreover, Koolhaas accuse of the distortion of reality that we suffer as guild the awareness of our own history, which based on myths and legends differs greatly from our daily lives. In fact, the Venice Biennale could be consider as a substitute for the history of architecture, an alternative look closer to the reality, to the average, than exceptions and oddities. This "quantitative" vision should be integrated into the curriculum of the departments of History. In addition, the instinct of Koolhaas has led to study the laws of market, mass culture, the culture of spectacle, the mass media and the culture of congestion. These are, in his opinion, the laws governing the world and under whose magnificent force architects have lost, without being fully aware of, the role that once had. The system has its own inertia and moves toward a horizon that we can only guess and accept. We can agree with the approach or not. However, we cannot deny that his analysis is distinctly contemporary and following the great issues of today. Consequently, these materials should also be part of a curriculum that allows students to have a broader view of the state of affairs. Theory and criticism and other nearby philosophy should assimilate and cope with the lack of representation of which they are accused.

Applying these findings to the area of graphic expression in architecture seems even harder and I can only display a certain timidity probably scratch in the warmth. Especially when you consider the Spanish culture is particularly formal—as constantly aiming Thomas Mann in "The Magic Mountain"—and architectural features traditional inertia that relies more on doing that thinking. Interestingly our culture is absolutely real, as Ortega said, but in a quite different sense Koolhaas. Perhaps, and the suggestion will sound obvious, it would underline the instrumental condition of the drawing. Just as it has been used until now teaching drawing as a gateway to a new sensibility, this sensitive paradigm can swing toward new, closer to the reality that outlines the Dutch master's contemporary values. The drawing, which itself is already shared by several disciplines should be used to understand the abstruse reality space. The graphic expression would be the threshold to cross knowledge and an awareness of problems whose complexity is such that not resolved from a single discipline, even from architecture. Just having this really present in education and would be a great contribution.

All this has led Koolhaas to the aforementioned waiver to overcome disciplinary boundaries and to apply a heavy dose of realism to understand that our capacity for action gives way to an obvious manipulation. If anything, you can be accused of targeting but not answer questions, to circumvent the exemplary nature to which, it seems, it requires visibility. The Dutch master does not articulate universal answers. Could we not or should we not do anything? Henry David Thoreau opened *Walden* (1854) with a chapter entitled, precisely, "economy" and claimed it is synonymous with philosophy. However, rather than bow to reality, the writer rebelled against an alienating system and set a path from the action, with its small cottage on the shore of the lake. If what said Koolhaas is a good diagnosis, it should acknowledge the destabilizing impulse, although is not revealed an overcoming integration. If his look is quantitative (and not qualitative), the more suitable than others for teaching. Show realism to students would avoid a lot of confusion because, after all,—and going back to Ortega to state it the other way—Art is necessarily minority and the group of architects it ceased long ago.

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Architectural Drawings and Symbolic Systems. Implications of Goodman's and Gardner's Theoretical Approaches in Project Zero

Ángel Allepuz Pedreño

Abstract Goodman and Gardner launched *Project Zero* at the University of Harvard, as part of it the art education programme *Arts Propel* was later developed. Concepts as notational and non-notational can be a useful tool to classify architects' varied graphic productions. Goodman's work has identified cognitive activity as an effort to understand and to create our world; in order to achieve this goal we have adopted symbolic systems. Both science and arts are specific symbol systems. According to Goodman, the aesthetic experience is a cognitive experience. The application of his aesthetic theory enables us to analyse architectural drawings. In addition, it allows us to identify specific skills to solve particular problems, something which Howard Gardner refers to as multiple intelligences. These abilities may be used with an artistic purpose. Part of the findings developed within Project Zero can help us to organise better our graphic teaching at architecture schools.

Keywords Architectural drawing · Project Zero · Nelson Goodman

1 Art and Cognition: From the Ontological to the Epistemological Dimension

It is necessary to determine the hoarded knowledge with regard to the human activity we call art. Not every author identifies art with an activity aimed at a better understanding of the world; on the contrary, the ontological dimension, be it expressive or emotional—to name a couple—, often prevails over the epistemological one. Regarding this subject, researchers who have expressed their interest in aesthetics and art theory can be classified into two different groups: Anti cognitive and cognitive philosophy. Our interest is focused here on exploring the attitudes

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and interpretations that tend to make of aesthetic experiences a way to achieve knowledge through emotions.

The question whether art is able to provide knowledge or not is as old as philosophy itself; this debate is known as the "epistemic question". However it should be posed together with another inquiry, that of the "aesthetic issue". Thus, the question could be stated as follows: Provided art is able to increase knowledge, does such achievement increase its aesthetic value, its artistic significance? Aesthetic cognitivism implies the conjunction of both issues: First, that art is able to produce knowledge—something which is not evident—; second, that this capability is in fact a measure of the quality in a work of art, of its aesthetic value.[1]

Until recent dates, not only for the unexperienced but also for scholars and art researchers, art constituted the realm of emotion, mystery, magic and intuition. Nelson Goodman blamed "the prevailing dichotomy between the cognitive and the emotional" (Goodman 1968, 224) for many of the problems he had to face in his research.

One of the fundamental purposes of Goodman in his *Languages of Art: An Approach to a Theory of Symbols* was to show art as a version of the world very close to those activities such as science through which mankind understands and builds the world. His analytical approach of the aesthetic problem carried Goodman to focus on aspects of the arts which are relatively accessible and feasible to analyse.

We are indebted to Goodman for introducing the radical shift of giving up the question "what art is" to raise another instead: "When should something be considered art", and "when does something operate as a work of art." For Goodman there is no art other than the work itself. It is the work of art that which holds what art is or may become. Not does even it depend on the intrinsic conditions that the work entails or on those which have been produced by the author; it is not a matter depending on its configuration laws, its constitution or its internal composition, as the same object may or may not work as art depending to a particular circumstance. In fact, in Goodman's opinion, it is this functional condition, this factic rank, what gives it its artistic *status*; only if it works as such it must be a work of art.

The turn from the ontological approach to the epistemological one is thus stated. Consequently, how does a work of art function?[2] We do not know, or at least we are not aware of Goodman openly addressing this issue although he does it indirectly. Nevertheless, he intensely strives to state the symptoms that should be present in a work of art—in greater or lesser magnitudes and with varying degrees—referring to it as "symptoms of the aesthetic". They all refer to the conditions present in a work or art—or in any of its parts—understood as a symbol (Fig. 1).

[1]For further detail on these arguments refer to the text by Sixto J. Castro (see references).

[2]What it is indeed made clear is the "function of art", which allows us to have an approach, to help us to understand the world through the formulation of a possible world, a version of it, a reality as useful and rigorous as that presented by physics or philosophy. But not just any version, there are some better than others. He refers to his idea of the "samples".

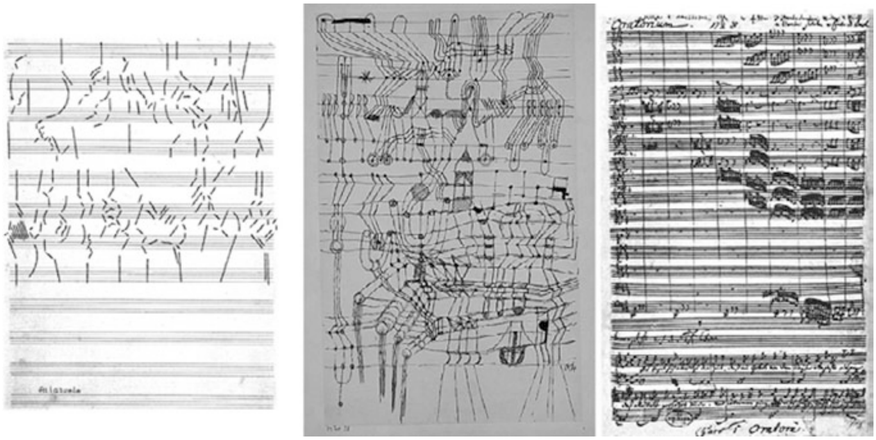

Fig. 1 *Composition*, painting by P. Palazuelo, painting by P. Klee and J.S. Bach's score. *Author*: The author

2 Symbolic Systems, Notational and Non Notational

In the last decades, the important role of the ability to use different symbols and symbol systems played in human cognition has progressively been accepted. The manifestations of these actions are publicly evident in literature, architecture, drawings, maps, body language, etc., but the mental processes required to perform them remain hidden and must be inferred in different types of activities. Goodman was among the first to question the widespread notion of the primacy of logic and linguistic symbolic systems over expressive and communication systems. His approach is *cognitive* since, considering certain aspects, artistic activities are claimed to be a field of mental activity and therefore anyone related to the arts should be able to *read* and *write* according to the specific symbolic systems characteristic of each art.

Two different categories of symbols may be distinguished: The symbols of the first order, whose use is acquired in a natural way within a particular culture between two and five years of age, and those of the second order, invented (or notational) symbols such as writing and numbers, which must be learned at schools. The challenge of formal education is to successfully face and resolve the conflicts that arise between the symbols of the first order, acquired before going to school for practical purposes, and those of the second order, that are learned gradually.

3 Architectural Production, Built Work and Architectural Drawing

Goodman's theory of symbols is valuable for us because it deliberately addresses architecture, something rather infrequent in studies of philosophical aesthetics.

More specifically, it analyses architectural drawings, mainly focussing on the classification of graphic documents, conferring a prominent role to architectural drawing at the expense of built architecture.[3] It also allows to clearly distinguish the notational or non-notational—imaginative—character of the different drawings based on the use of graphical symbols employed in architectural plans. Together with the discrimination between the pairs *sketch-diagram, analog-digital*, and *script-score* is shown as an effective tool to classify the full range of drawings produced by architects. This theory is also useful to identify different qualitative aspects of architectural drawings through the detection of aesthetic "symptoms" present in these drawings such as their syntactic density, their semantic density or their syntactic repleteness[4] (Fig. 2).

4 Artistic Activity and Teaching

The identification of certain aspects of a symbol is clearly connected to certain skills the individuals who generate them must possess, but also those who interpret or analyse. This relates cognitive ability, a specific individual skill to understand certain symbol systems, with artistic activity. Consequently, the bridge from the field of aesthetics to that of psychology is thus established, giving way to the interaction between Goodman and Gardner in the research developed within the Project Zero[5] at Harvard's Faculty of Education.

From the seventies onward, under the direction of Gardner—head of the Evolutionary Group—and David Perkins[6]—which focused on the study of

[3]A relationship between symbol systems and architecture is exposed in the Ph.D. dissertation defended by Remei Capdevila Werning; excerpts of these ideas can be found at: Capdevila Werning (2012).

[4]A possible link between Goodman's theory of notation and the classification of drawings produced by architects is developed in Allepuz Pedreño and Marcos Alba (2015).

[5]Goodman founded it in 1967 at the Harvard Graduate School of Education.

[6]David Perkins holds a Ph.D. in Mathematics and Artificial Intelligence at the Massachusetts Institute of Technology (MIT). To give an idea of his research interests and their relationship to our field of study we cite three of his books:

The Arts and Cognition (Perkins, D. N., & Leondar, B., Eds. Baltimore: Johns Hopkins University Press.), (1977).

Art, Mind, and Education (Gardner, H., & Perkins, D. N., Eds. Urbana-Champaign and Chicago: University of Illinois Press.), (1989).

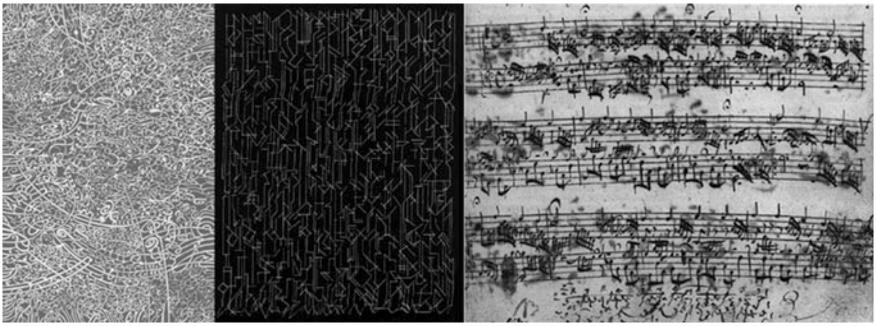

Fig. 2 *Composition*, painting by P. Palazuelo, painting by P. Klee and J.S. Bach's score. *Author*: The author

cognitive and perceptual abilities of adults—, Project Zero took on a more psychological dimension to become a project focused on educational practice during the eighties.

5 Multiple Intelligences

Gardner's theory of multiple intelligences (MI) is based on identifying the type of problems that humans are able to solve and deducing the kind of intelligence that should be involved in their resolution. In any developed society problems require the use of different kinds of combined intelligences; therefore, each and every one of them should be encouraged within the educational evolutionary trajectory of the individual so that his bio-pschycologic potential is allowed to surface. Gardner identifies seven different intelligences that can be found in every individual with varying degrees[7] and seem to form natural classes; amongst them no "artistic intelligence" is to be included. Technically, he suggests, "intelligences are not inherently artistic or non-artistic. Intelligences work in an artistic fashion in as much as they explore certain properties of symbolic systems. Spatial intelligence can be used in an artistic way by a sculptor or an architect, or in a non-artistic way by either a geometer, a topographer or a surgeon. In principle, any individual who does not have a brain damage can reach significant levels in any intellectual field; the cultural environment will determine the level reached by each individual's

(Footnote 6 continued)

The Intelligent Eye: Learning to Think by Looking at Art (The Getty Center for Education in the Arts), (1994).

[7]According to Gardner logical-mathematical and linguistics are two of the best known for their easiness to be quantitatively evaluated; the rest being: Spatial, musical, bodily-kinaesthetic, intrapersonal and interpersonal intelligences (Gardner 1995, 26).

intellectual potential. If so, schools may be considered a powerful cultural environment; something which prompts us to inquire: What can then be done to educate the talent?[8]".

In accordance with it he adds elsewhere: "Considering a pluralistic understanding of the intellect, the question of whether is there an independent artistic intelligence immediately arises. According to my analysis, there is not. Instead, each of these forms of intelligence may be oriented towards artistic purposes; i.e. the symbols involved in such a form of knowledge may be arranged aesthetically." (Gardner 1995). This idea was to be confirmed five years later (Gardner 1999, 118).

In our field of research it is interesting to deepen in the definition of one of these seven intelligences: Spatial intelligence. Its origin stems from the human ability to solve spatial problems such as may be that of orientation,[9] navigation, the use of maps as notational systems, the visualisation of objects from different points of view, the game of chess or the visual arts. Gardner identifies the right brain hemisphere as the area where space calculation is based.

Blind people provide an example of the distinction between spatial intelligence and visual perception. An intelligence can operate independently from a specific kind of stimulus; indeed visual perception is replaced in blind individuals by tactile perception allowing thus to perform spatial reasoning. Gardner illustrates this with an example: "Sailing in the Caroline Islands of the South Seas may be performed without instruments (…). The sailor cannot see the islands while sailing; instead he projects the positions of the navigation route in a mental 'map'" (Gardner 1995, 39) (Fig. 3).

These and other investigations resulted in specific research projects within the Project Zero developing different aspects of multiple intelligences, the development of artistic skills, possible pedagogical implications or the development of innovative assessment methods that can help us in our teaching of architectural graphic expression. We will now turn to these issues.

6 The Evolutionary View

The research done by Gardner's Evolutionary Group is interesting in our field of research because it focuses on the study of the artistic development of individuals grounding it on creativity. It takes into account Piaget's evolutionary ideas and observes how the acquisition of skills in the use of symbols as described by Goodman occurs.

[8]Gardner makes an accurate account of definitions, which can be summarized: intelligence, talent, prodigiousness, expertise, creativity and genius (Gardner 1995, 67).

[9]This field has recently been approached successfully and has led to the Nobel Prize in Physiology and Medicine in 2014 to two different groups of researchers, John O'Keefe, professor at University College London, and the team of May-Brit Moser and Edvard Moser, for the discovery of the neural mechanisms involved in the generation of maps within the brain.

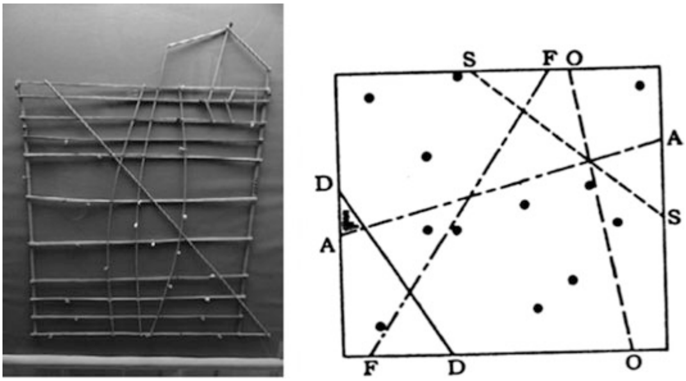

Fig. 3 *Left* Nautical chart elaborated by the people of the Marshall Islands. *Right* Simple notation system devised by John Cage, concert for piano and orchestra. Image used by Goodman in "The languages of art"

Based on these studies a series of "unexpected" findings were derived which we may shortly list considering the interest it implies for our teaching:

(1) In most areas of development children skills improve with age. However, in different artistic areas where children have high capacity in early childhood this is not so; in many cases, they may lose these abilities during intermediate stages of schooling never to recover them.
(2) Children's drawings would be an example of self-generated knowledge because it is triggered without the supervision of parents or teachers. In this, artistic learning also contrasts with other learning processes.
(3) In all areas perceptual and comprehension skills are developed before productive abilities. By contrast, in art education—at least with regard to certain abilities—understanding seems to follow the development of productive capacity. Children learn through acting, building or doing. We understand after having produced things.
(4) Children develop their skills in different areas at an unbalanced and unearthly pace. They may be good at one or two competences, normal in others, and below average in the rest.

Let us further develop the first point. After Piaget's findings, Gardner distinguishes between stages of development by age groups and wonders why the imaginative and the creative capacities that show boys and girls during childhood hardly survive into adulthood when it is generally stunted. Gardner refers to the existence of an early phase devoted to a direct knowledge of the world up to two years of age, and a subsequent period, lasting another five, dedicated to a symbolic knowledge of it. Another phase follows which Gardner coins as "literal" (Gardner 1982, 109), in which children refer to reliable copies of literary and graphic models, rejecting any deviation from acquired canons and conventions. In the pre-teens, having dominated the symbolic system, an acceptance of the variations it may

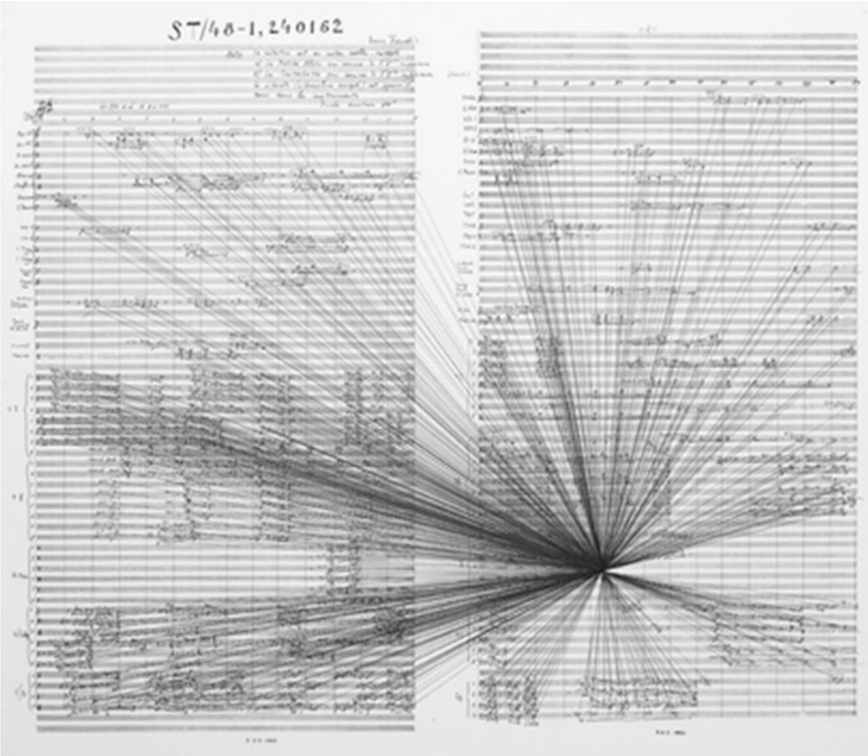

Fig. 4 Iannis Xenakis musical notation systems

produce and the compression of works produced by others is reached. It is at this stage when the ability to understand and evaluate the most important qualities of the arts such as those of balance, composition, expression, style and abstraction is acquired. However, only a few after adolescence resume artistic activities. According to Gardner, the difference lies indeed in the fact that the child is unaware of the symbolic systems that sustain each art, while the mature artist is fully aware of the existence of rules, thus approaching to creation with determined awareness of the cost that any modification may imply (Fig. 4).

Gardner supports the idea of the existence of an innate factor, a talent, a specific skill which either you have or you lack. Nevertheless, he stresses the need to control the environment in which this talent is developed through its promotion just during the phase in which the child is eager to learn the rules, techniques and the way things are done.[10] The child must reach adolescence[11]—the "sensitive period"—

[10]See "El niño de diez años: adquisición del dominio de las reglas de la especialidad" (Gardner 1995, 72).

[11]Extending from fifteen to twenty five years, thus covering the period of university education.

with a high technical mastery—being an excellent performer in his field—to overcome the stage of intense self-criticism characteristic of the teens; otherwise he will cease to strive. However, this may not be enough; the distinction between artist and competent craftsman depends on a factor of personality and character; it is the desire to achieve greatness, firmness and perseverance that allows the artist to return again and again to his project without falling into despondency or uncertainty. Finally, Gardner emphasises the importance of life experience together with continuous training and dedication.

The post-adolescence stage or that identified with the mature artist has a special relevance for us although, unfortunately, this stage is the least researched by psychologists.

7 Creativity in Mature Artists

At this stage the ability to relate different theories and diverse aspects within their field of interest is evidenced. This occurs during long periods of time. Work is characterized by certain "dominant metaphors", ideas that appear over and over again; it is guided by a conscious purpose that leads to develop new skills or tools considered essential to achieve the pursued goal. Mature artists are really fond of the work they produce, receiving the disappointments and rewards characteristic of love. They tend to embark on solitary adventures with high probabilities of failure and subsequent rejection. Piaget's followers claim that adolescence is the summit of intellectual development where the most complex thinking is reached, the stage of the so-called formal operations, something that shall not be modified during the life of the individual. What will indeed have a prominent role at maturity is the ability to identify new problems, to find new challenges and to discriminate between those resulting fathomable and those that are not.

8 Arts Propel. Artistic Training

This programme[12] was planned for high school students in order to create a specific focus on their training in artistic activities. Specifically it focused on the study of the activities to develop skills in music, creative writing and the visual arts—we will focus on the visual arts—. Its name corresponds to an acronym formed from the

[12]Currently it is not active and is listed as a past project in: http://www.pz.gse.harvard.edu/project_zero_past_projects.php.

words that summarize the skills involved: *production, perception, and reflection + learning*. These three competences are defined as follows:

- Production: Drawing or painting.
- Perception: Make a distinction or discrimination within an art form; "thinking" in an artistic way.
- Reflection: Trying to distance oneself from his own perceptions or productions, or from those of other artists, trying to understand the objectives, methods, difficulties and effects achieved.

Multidisciplinary teams were established to set the core competencies for each art form.

The experience led to the introduction of two educational processes: a set of exercises and the creation of a *processfolio*[13] to replace the portfolio or folder so that all generated material during the production process—roughs, sketches, drafts, etc. as well as works of art produced by others that students significantly like or dislike and that are related to the development of the work itself.

Unlike classical learning, the success of an arts education programme based on the *processfolio* largely depends on the role assumed by the teacher as he must participate actively, setting a highly productive and worthy level, providing an example to guide the group standards. In a later phase of the course this role is transferred to the students and their interactions with each other. During this phase a self-assessment procedure is proposed to the students by means of distancing and reflecting on the strengths and weaknesses of each produced composition, its expressive capacity and whether they have or not achieved the manifestation of its fullness. It appears that one of the thinking routines suggested by David Perkins is reconsidered here, specifically that to explore visual stimuli summarised as follows: See-Think-Wonder.

A set of procedures to evaluate the four dimensions of the creative process have been included in the publications of the working group led by Ellen Winner and may be of interest four our teaching activity. However, the necessary comment would take too long to include here and beyond the scope of this paper.

9 Conclusions

Goodman's work has allowed to identify cognitive activity as an effort to understand and create our world; to achieve this we have adopted systems of symbols. Both, the sciences and the arts, are specific symbol systems. According to Goodman aesthetic experience is a cognitive experience.

[13]For further detail on this notion see Gardner (1995, 160), which refers to other specialised authors such as N. Brown and Wolf.

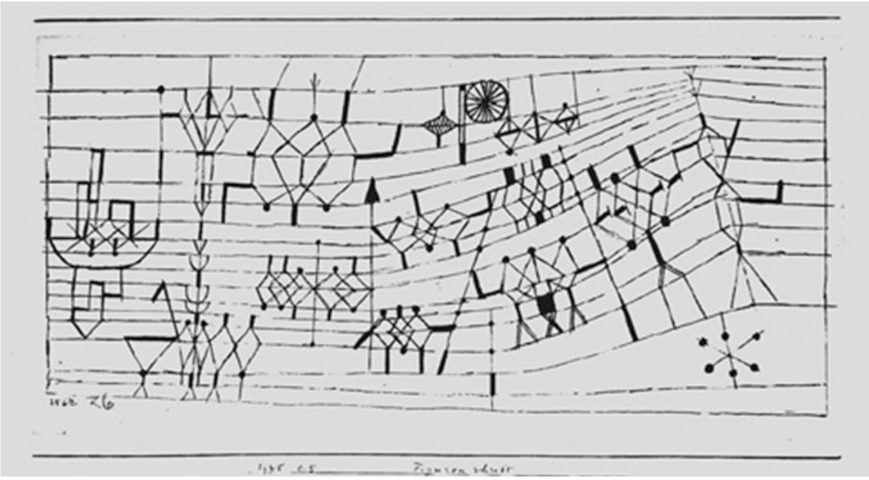

Fig. 5 Paul Klee drawing

The application of his aesthetic theory enables us to analyse the works and drawings of architects using the same categories employed in the other arts, distinguishing their notational and non-notational components. It also allows us to identify precise skills to solve specific problems. These skills would be the so called human intelligences (MI), all of which are present in varying degrees in humans, and may be developed with adequate practice even during the mature age. Different intelligences can be used with or without an artistic focus or purpose. The implications of these findings in the pedagogy of art education has been evidenced by the research work developed in the *Zero Project* at Harvard's Faculty of Education. Of special interest to us can be the arts education programme called *Arts Propel*, focusing on students aged between 15 and 25 years. A programme based on the assertion "first produce, perceive and then reflect on what you make" where production processes, criticism and self-assessment are the ultimate goal to enable students to distance and attain a degree of autonomy from their tutor, which will gradually yield the leadership and expertise deployed at the beginning of the programme towards the disciples (Fig. 5).

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Ángel Allepuz Pedreño Holds an Architecture Degree at E.T.S.A. Madrid (1993) and a Master degree in Sustainable Architecture and Urbanism at U.A. (2014). He is currently associate professor and researcher at the University of Alicante (2000). His field of research is focused on drawing as a vehicle of thought and its relation to learning, analysis and production of architectural designs. At present he is working on his PhD dissertation on architecture as an object of knowledge deduced from the analysis of graphic documents through the use of visual thinking in contrast with the phenomenological experience of built architecture.

The Teaching of Drawing in the Graphic Design Study Courses

Stefano Chiarenza

Abstract In recent years, the development of new educational courses, focused on the training of professionals in fashion and graphic design, both in university curricula, than in that of Fine Arts Academies, offered new perspective to the representation's discipline. In a field that considers the image as the essence of communication, the graphic representation—and, specifically, the drawing's discipline—constitutes a basic element. The presented paper, through the results of educational experimentations and research experience, aims to highlight the role of drawing in the field of the graphic design.

Keywords Representation · Graphic design · Didactics of drawing

1 The Teaching of Drawing in the Study Courses in Architecture and Engineering and in the Study Courses in Graphic Design

The knowledge of drawing and its teaching in Architecture and Engineering study courses has always been an essential requirement of professional education. From the drawing's history and representation theory to the applied research in the field of survey, a number of courses belonging to this subject area has been, and still is, the basic substrate in the curricula of the various courses. This means that the drawing characterizes large part of so-called basic educational activities, and also defines an independent research area that has seen, over the years, significantly increasing the body of knowledge, with contributions and products of considerable importance both in theoretical field that applies.

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The advent of information technology has also interacted significantly with the subject area of the Representation. The possibility to use new innovative tools has actually had major repercussions in both teaching and research. In teaching, it has primarily changed the methodological approach and used both the greater expressiveness of computer graphics means that the best display capabilities for complex processes (Carlevaris et al. 2010). In research it has outlined innovative fields of application and new areas of investigation.

All aspects of the different courses related to drawing are therefore considered strictly functional to the definition of a specific professional identity. That constitutes a common denominator of the educational programs, national and international, in architecture as much as in engineering. These programs articulate in two main directions, namely "… As a teaching of the drawing, that is, as history teaching, the theory and technique of drawing, to learn how to represent images of reality and fantasy; … As a teaching arising from the drawing, that is, as all the teachings that come from the drawing" (De Fiore 1997). The knowledge of methods and criteria to represent the architecture and construction in general; the display of geometric features of form and technical and structural ones; the representation of the territory and its specific codes; the architectural, urban and environmental survey—just to name a few and the most common basic variations of the courses included in the specific subject area—therefore appear an indisputable premise of knowledge to understand and communicate the reality or to convey the design invention; but more in general for the construction of its graphic communications language.

The rise of computer technology and the rapid development of computer graphics systems led, over the past 10 years, significant changes also in teaching, often derived from innovative research experiences. In the elaborate process of communication, in which the graphical representation plays a basic role, the technological innovation of the instruments, with aided design programs, has given an original contribution increasing the learning path of the Representation disciplines, without altering or nullify it (Strollo 2008). Computer aided design, on the solid foundations of descriptive geometry, has changed the mode of attainment of the reality display results or those of the project, allowing to use a variety of perfectly rational approaches. Examples are: the solid modeling processes—that are now an established practice in the analytical and design definition of the architectural-engineering product—or BIM software; the digital survey techniques also integrated with image processing; and, not least among the elements that form an integral part of the teaching, the prototyping processes based on the 3d printing by software; or even the relevant research in the GIS field, that enable new approaches to the study of the territory or to the definition of large information capacity database.

Despite the considerable changes in didactics in engineering and architecture registered in particular in the Anglo-Saxon school—where modern practices and new industry trends have helped to reshape the role of graphic disciplines in the curricula—it appears in any case consolidated the address of the educational Representation courses to which a foundational value is still recognized (Cardone 2009).

The expansion of educational offerings of universities and the academies of fine arts in Italy, however, has seen in recent years, the proliferation of new courses related to specific needs of the labor market (Cocchiarella 2009), who exercised and still exert a strong pull for users, such as courses aimed at fashion design or graphic design. These appear to be strongly characterized by the graphic culture, but no common approach has emerged in the placement of the Representation area disciplines within the basic training of the related curricula. In particular, substantial differences can be found especially in the new courses of study offered by the Academies of Fine Arts. Here—since the structure of the training courses on the university model has taken place recently—they have been retained in many cases the characteristics of the typical artistic training, although addressed to the enterprise. In particular, the whole of the Representation disciplines has not been subject to systematic and homogeneous organization in the studies curriculum. Academic disciplines of representation are accompanied, and often replaced by traditional artistic and graphic disciplines (e.g. Illustration) or by technical-instrumental disciplines (use of specific software, multimedia design, etc.).

However even in these curricula a solid presence in the basic training of the Representation area courses—which, as in Architecture and Engineering, define a strong cultural background—not only would ensure a better development of design disciplines but would delineate for it new perspectives, both from the academic point of view and from that of research.

In a field such as that of Graphic Design, in which the image is considered essence of communication, and the boundaries between figuration and language take on symbiotic and ambivalent relationships, graphic representation—and, specifically, the drawing's discipline as projective or descriptive geometry, spatial representation techniques, etc.—constitutes a fundamental resource.

In the definition of an image that must become part of multi-directional communication, they appear indeed indisputable the deep ties between the graphic image structuring (lettering, corporate image, brand image, product image, etc.) and projective or descriptive geometry; and between the visual expression and graphical semiology (Chiarenza 2012). The methods of representation, as well as the study of the geometric projective transformations or, more generally, the graphic message communication, far from being considered an exclusive utility in configurative architecture research, they find a very wide application in the definition processes of the graphic communication. Through a process of abstraction they allow to face the concept and reality in representative forms in which being and appearance, the real and the concept of the real become specular (Fig. 1).

In the light of these considerations and of the teaching activity carried out in recent years at the Academy of Fine Arts in Naples, in the course of studies in Graphic Design, it seems interesting to propose the results of some experiences that highlight the centrality of representation in general, and in all its various forms. A representation that is necessary, therefore, as a basic tool in a graphics design path, in which the awareness of methods, rules and instruments can only enrich the design process.

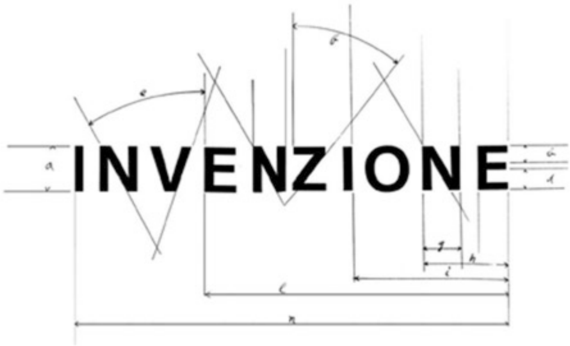


Fig. 1 Bruno Munari, Invention

2 Teaching and Research Experience. Geometry and Image

In the composition of the visual message, the geometry is always complementary to information. It is the foundation of the visual image, the direct component of the form and the process leading to the organization of the communication message. The geometry allows to give a rational construct devoid of arbitrariness to the graphic sign. In the analysis of visual communication messages, the ability to make known the rationality of a choice appears as a way to access the creative thought. The discovery in the visual image structure of figures, proportions, forms, numerical relations, rational transformations, justifies to some extent the design intuition, and reveals, in retrospect, the key steps in the creative process (Fig. 2).

The development of a project, in fact, is often done resorting to intuitive balance, structural articulations which are not always the result of rules, systems or pre-built geometry. However, the knowledge and the analysis of various aspects of the graphic message, to discover some hidden structure that reveals its nature, gives the operator the opportunity to structure visual images most appropriate to a given communication, working on the aesthetic of the geometric-mathematics structuring (Fig. 3).

The analysis and comparison on the graphic image structures, whether for the definition of a brand or an advertising campaign (advertising), allow to bring to light meanings and reasons of forms not always perceptible at first glance, extrapolating, in many cases, reports addressed to the intellect first, and then to the emotion of the senses.

If the shapes and fundamental geometrical figures represent the semiotic basis on which is articulated the graphic communication, the process of the meaning construction is often processed by resorting to assemblies and forms modifications. Some laboratory research experiences undertaken have shown, for example, that the most significant transformations used in the graphic design are those so-called isometric and projective (Chiarenza 2014).

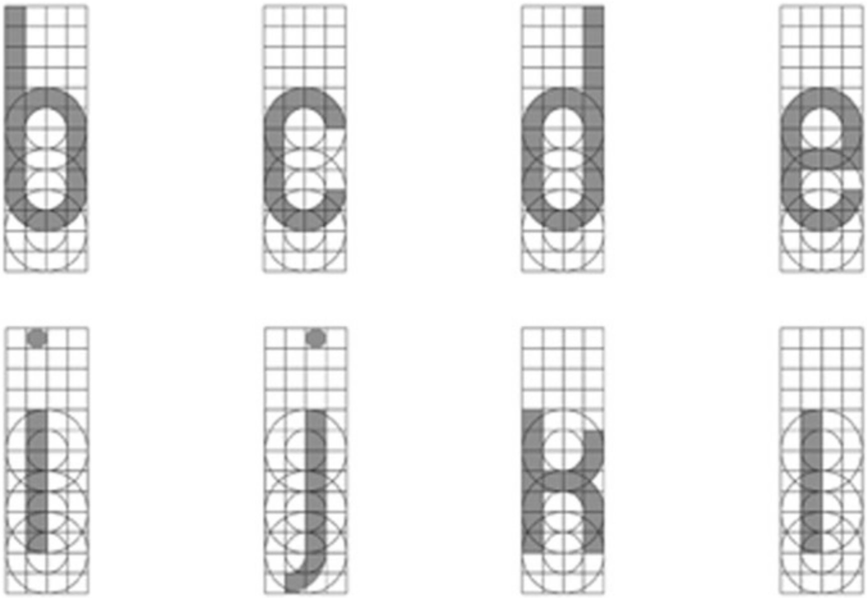
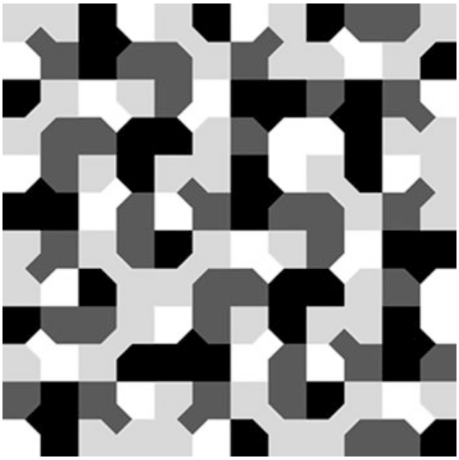


Fig. 2 Joost Schmidt, Bauhaus logotype

Fig. 3 Bruno Munari, Peano's curve, 1974



The first gives rise to a set of associative phenomena, of growth and visual rhythm, and are able to attribute semantic values to the image.

Plane projective transformations, however, obtained through the fundamental geometric operations of projection and section, constitute a set of relations through which it is possible to transform shapes into other shapes, according to a biunivocal correspondence such as to retain many of properties which often make it possible to

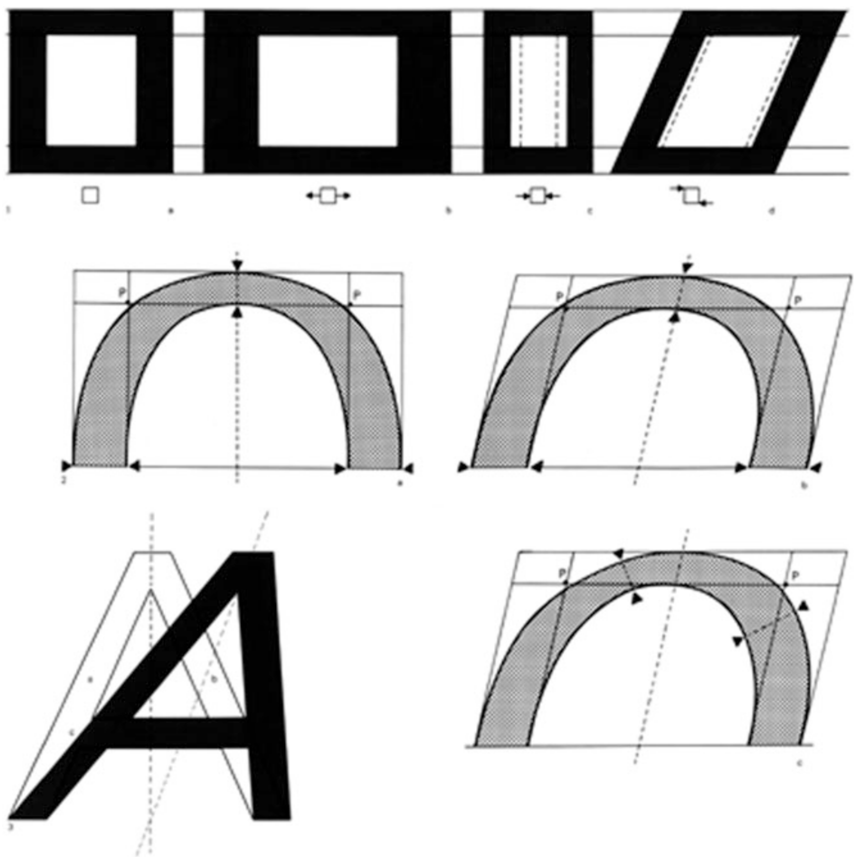


Fig. 4 Adrian Frutiger, scheme of typeface distortion phenomena by projective transformations

recognize the transformed figure even if its metric characteristics are altered. They are called projective properties of figures which include both graphical ones and those projective-metric (Fig. 4).

The use of such transformations, by projections and sections, appears particularly significant in the field of graphics, so that the knowledge of how to transform a figure represents a skill extremely useful in graphic design.

If the geometry in general plays a key role in the figurative genesis of the image, it is specifically interesting, the graphics power inherent in the projective transformations of the forms. Among the main transformations, related to projective processes applied in graphic design, we can find the homological transformations in the plane. They can also look like the Euclidean geometric transformations (translation, rotation and symmetry) and similitudes (translation, rotation and homothety), but the opportunity to bring them back to cases of projective transformations allows us to extend the same criterion of reading even to the isometric and perspective correspondences—that also are frequently used—thus being able to recognize in the drawn shapes, the persistence of similar characteristics, projective and topological. Through the application of these projective processes to the figures, it produces a transformation of signs which are however strictly related by the mathematical and iconic point of view: in them it is possible to recognize, in fact, despite the obvious and significant variations, an objective expression of the original object or shape, given the persistence of so-called invariant characteristics (Eco 1998).

These processes are also adopted in order to generate complex shapes as a result often about accumulation or distortion of congruent shapes.

It is clear, then, that the use of projective and descriptive geometry principles highlights structural and topological relations between graphic configurations which constitute the very essence, figurative and functional, beyond any merely formal data and therefore metric-dimensional. Relations which, as they pertain to a non-metric and quantitative geometry but relational and qualitative, reveal the complexity of laws and relationships that govern the forms and images, and that thanks to the geometry can be deduced. The search for structural essence within the visual image created by the graphic designer appears therefore as an indispensable approach. In fact, the rationality of the image cannot be enclosed only in its formal logic. It creeps into his geometric structure that, thanks to the ability to catch emblematic and profound reality characters, is able to transform quantitative and sensitive properties in qualitative and relational properties (Fig. 5).

As Durand notes, the structure can "enhance the notion of 'shape', conceived first of all as empirical residue, and also as semiotic abstraction, resulting from an inductive process. The shape is defined as a stop, as fidelity, as immobility. The structure implies, on the contrary, a certain changing dynamism" (Durand 2009, 65). The expansion of the shape in the structure is evident because the morphological genesis of that one is displayed by the structure itself. A genesis which

Fig. 5 Bob Noorda, Brand for Enel Company

follows specific rules but is dynamic at the same time. Indeed, the shape's structure can be considered as generative of innumerable varieties of shapes, however, all satisfying identical rules and functions.

So, in the process of the shape's structuring, typical of graphic design—or design in the broadest sense—the geometry can not only be considered as the science of measurement and, therefore, just addressed to the morphological and dimensional properties, as suggested by the etymological sense of the word. But it should be extended, with its connotations of projective geometry, and even more of the topology, including it the possibility to formulate laws dynamic and generative, and for that structural.

Through geometry you can give substance not only in the iconic sign, but also to the words that often co-exist with it, so not as much contributing to the language field as to the structuring of the character. A logical configuration that avoids the irrational, even if it brings the viewer mind beyond the limits of the image and language.

To reach a careful knowledge of the image's structure, and of graphic signs that compose it, therefore, we must understand the inner reasons and the dynamics laws underlying its development and its possible combinations. An investigation, at the same time analytical and critical, that completes the visual experience and offers the designer the opportunity to consciously act on the external shape of the image, in order to search for a deeper objectivity: an objectivity that does not stop at the surface, but that is both essence and universal substance of the content.

The coordinate image, the visual identity, the icon of the product, are all instruments for visual communication with which the graphic designer constantly has to deal, helping to develop and modify the structuring process of these image's layers. Indeed, through the quality of the image improves communication quality of their underlying values. Actually, just to the image, as a more immediately decodable communication medium with maximum expressive universality, it is entrusted a fundamental task, namely that of the intellectual involvement. As Kepes notes "… perceive a visual image implies the observer's participation in a process of organization, since the experience of an image is a creative act of integration" (Kepes 1971, 22). Then, the designer has to control the visual language, giving to the meanings a corresponding sensible presence. In this sense, he must be able to carry out a symbolic abstraction, transforming the conceptual contents of the communication in a system of signs decodable in immediate and unambiguous way. In this search of the deepest character of reality, the geometry's knowledge has a fundamental role, allowing to confer meaning to relations, qualities and functions of the phenomena—that is to analyze and understand significances, and then translate them into signs. So we are able to understand their inner coherence, also figurative.

3 The Representation of Space-Time Sequences in the Visual Image Design

The drawing of a process or action, or the communication of information about a process through the graphic illustration, is today, a further field of research, open and full of significant developments (Anceschi 1992). In the era of the knocking down of the verbal language barriers, thanks to the social relations that create multiple interactions through a variety of alternative media, increasing attention is being addressed to the development of visual communication techniques, which are a system of efficient and effective popularization. The visualization, in fact, as the verbalization, generates a real language with precise structuring rules. And more and more complex becomes the task of translating concepts and processes into images, combining different set of competencies that is, those graphic-engineering with the psychological ones; those psychological-perceptive with those properly artistic.

The role of communication through images is also of paramount importance today in the learning process, in which the spatial abilities in the acquisition of knowledge appears significantly stimulated by the use of words and images. The aim of some personal experience of research, carried out in recent years in the field of the spatial representation for Graphic Design, is to identify the role of the graphic representation in the communication processes, and to highlight how the image involves and influences both spatial learning ability more than traditional verbal processes. There are various studies that confirm the power of visual aids in the transmission of information and we can believe that, along with computer animations, these represent the means potentially more effective to present information for learning procedures, from the visual instructions to the scientific explanations and the data display. In the field of communication through visualization, the attention was focused, for example, on the design of instructions—such as those of the operating instructions or assembly of objects, or a path’s indications in the public spaces—namely those tasks that require explanations of actions in space and time (Fig. 6).

In this specific type of visual communication images have to be arranged in a precise spatial-temporal configuration and require important representation and reading skills.

The representation of these processes has been extensively studied under different points of view, taking into account both the structure and the spatial-temporal configuration, of course without neglecting the Gestalt and the aesthetic-graphic components.

The research has been undertaken through two fundamental phases: a first focused on the collection of documents, from different fields, which have as object visual representations of processes, in order to create a vast repertoire, in the form of database, able to constitute a significant source of study. A second step, of critical analysis, useful to extrapolate a set of recurring characters (syntactic structures, articulations spacetime, etc.) and choices (representation methods,

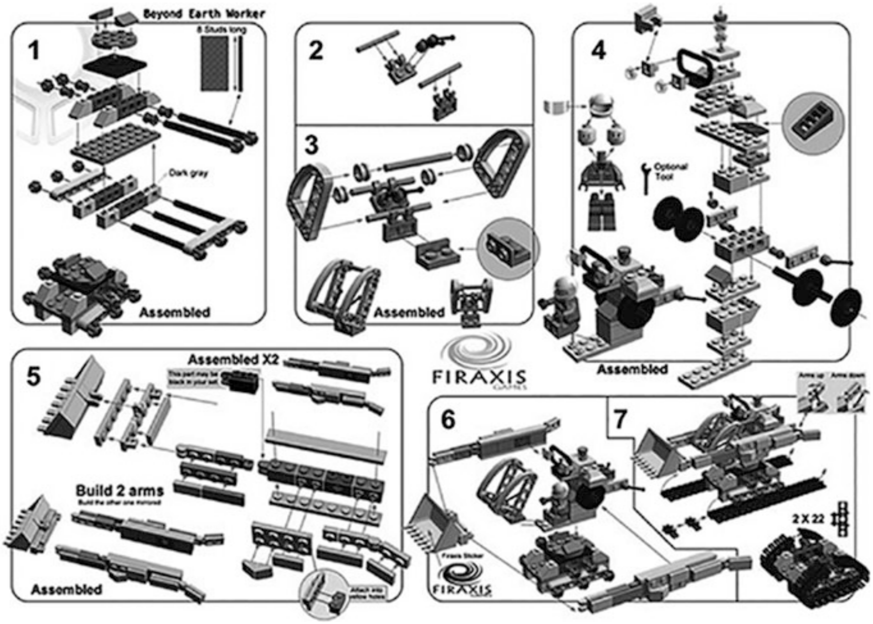


Fig. 6 Assembly instructions of a construction toy

layouts, colors, typographic fonts, verbal references, etc.) in order to understand the possible structuring of a language based on elements and reading mode widely shared.

A significant teaching experience has contributed to the outcome of this second phase of work. This, on the basis of the latest research in this specific field, has been given to graphically display different processes (assembly, operation, actions) that were then read by different groups of students in order to assess its results. From the instructions on the use of devices to the mounting instruction and the infographics to orient, used in public spaces, it has been highlighted the ongoing search for a language that does not need the verbal culture and, overcome language barriers, is able, through visualization, to convey complete and effective messages and directions that might otherwise require long and complex translation and description processes, sometimes lacking the same capacity of conveying.

There were then considered the most significant cases—those most successful in relation to the analytical deductions performed—in terms of spatial arrangement, temporal sequence, conciseness of images (or pictorial symbols), graphic symbols (related to images, conceptual or arbitrary), and verbal references, with the aim of verifying the most effective ones in terms of understanding and consequently the cognitive approaches for the construction of better designs of processes, such as the method of segmentation of the actions in step by step diagrams and phases, the expression of the dynamism of the action or the symbolism.

There were then collected, in various fields, different sequences of images—*visual design* products—aimed at the transmission of information on actions (think for instance to the instructions on security procedures present in aircraft which also follows the visual-gestural explication by the flight attendants in order to go beyond the limits of the verbal language; the instructions for the use appliances; the explanations of games; toys instructions for children, etc.) or manufacturing processes (e.g. the installation instructions of a mechanical object, etc.) (Cheng 1996).

However, they were considered examples where there was a space-time implication.

After an overall task of classification, it has been carried out, primarily, a research on the syntactic structure of the visual schemes by analyzing them in detail. In this phase it was not taken into consideration the aesthetic value of displayed information, on which nevertheless they were made some remarks in the margins.

From this study, as well as from the diverse research linked to recent field tests in cognitive psychology, there was evidence that as in verbal narratives, also in visual communication processes through the illustrations it can be find a logical structure of the speech consisting of a sequence well marked by a beginning, a middle part and an end. The beginning generally is an introduction; the middle part consists of the development of a sequence of procedures—so-called step-by-step—in which the graphic and aesthetic appearance often plays an important role; the end is marked by indications of activity completion with a final-sate diagram. The presence of a narrative structure has been observed in several studies (Denis 1997). From a semantic point of view, it was possible to note how the representation of objects is performed with static images while the actions are characterized by the interrelationships of images in a sequence that alludes to the dynamism (Fig. 7).

Fig. 7 Motion of the swing execution in the golf's game

The communication of information through such visualizations has now become extremely common and has been tested over the years, in an informal manner, just by the users. This has led to continuous improvements and enhancements that have revealed the fundamental principles behind the design. Like all forms of communication, including the visual-related processes (e.g. instructional design), to be effective, must be represented properly, underlining, highlighting, and if necessary distorting the essential information and eluding rather those non-core. It is clear that to achieve significant results it is essential the collaboration between graphic designers and experts in different fields.

Through a research based on critical and analytical studies and a phase of experimental didactics, particularly focused to the expression of instructional design, it has been highlighted on the one hand the presence of a syntactic structure in the depicted diagrams, on the other the existence of special display mode of spacetime dynamic by static figures. The manipulation of these processes allows to convey in the observer's mind at the same time concrete information and abstract concepts. This form of communication thanks to the images takes place in a direct and silent way.

4 Conclusions

The teaching of the disciplines of Representation in the Graphic Design courses, then, appears crucial in the definition of specific professional training. In the graphic image design, in fact, an approach based on the knowledge of the communication codes of the drawing and geometry, significantly defines the relations between designer and user, sender and receiver. In particular, as exemplified in some experimentation reported, the systems of space definition play a major role in the process of interaction between viewer and representation, becoming a strategically crucial tool to guide the understanding of the meaning of the image. A well-structured teaching within the curricula allows—beyond the aspects shared across the various fields of knowledge—to shape and direct the teaching on specific subjects for which there are many, as unusual, research horizons.

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An Analysis of the Work of Pedro Muguruza (1893–1952): Student and Teacher at the Madrid School of Architecture

Carlota Bustos

Abstract Architect Pedro Muguruza (1893–1952) was a pivotal figure in the Spanish architectural culture of the first half of the 20th century. He was student and professor at the School of Architecture in Madrid. In this article, I will present a brief overview of his drawings, within the context of the teaching of architecture.

An analysis of the work by Pedro Muguruza Otaño (1893–1952) from his time as a student and lecturer enables us to review the matter of teaching architecture a century ago. As regards Muguruza's period of education, it is worth noting that he studied for his degree in the Madrid School of Architecture from 1909 to 1916, with the last study curriculum of the 19th century. The syllabus was from 1896 and it included an entrance exam with tests on line drawings and watercolours, as well as figure and statue drawings. This involved two years' preparation studying in the Central University's Science Faculty. Then, lastly, there were four years of special learning, which was given in the Madrid street *los Estudios*.

Muguruza's teachers and colleagues included Velázquez Bosco, Palacios, Lampérez, López Otero and Torres Balbás (1919, 1923). In order to take into account the context of the generations of architects educated at the turn of the century, one must consider the eclectic and traditionalist foundations of educational organisation at the time, in line with the architectural culture of the period. As is well-known, the avant-garde, innovative trends, which in truth were put into practice by a minority, did not begin to be introduced into Spain until the twenties. Nevertheless, Muguruza did not choose modernity; like many others he adopted a traditionalist posture.

Muguruza's drawings as a student show the attention paid to the history of architecture. One of them shows an axonometric projection of Hagia Sophia in Constantinople, then a common practice for analysing the construction systems of Byzantine architecture. Muguruza created a complex representation that not only

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conveys the building's wealth of space but also a detailed description of the structural aspects, where the central dome and the diagram of the vaults and the counteracting forces are shown in cross-section (Fig. 1). Another of the student's works (six of them are preserved in the San Fernando Royal Academy of Fine Arts' Library-Archive) convey the process of assimilation via different techniques and semantic codes of drawing from different artistic ages. Natural drawing was, in addition to a tool for carrying out the project, a means of graphically understanding, learning, assimilating and reconstructing the architecture of the past. The renowned work *Cien dibujos* (A Hundred Drawings) is a good example to get to know Muguruza's graphic career (Muguruza 1932, 1943).

His educational period is also known via the graphic records generated for the drawing competitions held by the Madrid Circle of Fine Arts. These events enabled projects to be carried out beyond the teaching syllabus of the university course. They also helped them become known among the members of the jury, comprising, for example, Palacios and Zuazo. As far as is known, Muguruza entered two of these competitions in 1915. In one of them he took part in an exercise whose aim was to develop "original architectural ensembles and sketches of architectural ideas".[1] The other was held with the theme of the restoration of Roman cities.

For this second competition, a series of views was created for which a truly historicist reconstruction of Sagunto was put forward (Fig. 2). The project is a recreation of the city's classical past and its theatre, Via *Circense*, forum and basilica. These drawings were executed with agile strokes that were precise as regards what they intended to show, and revealed a thorough knowledge of this architecture. Some of the sheets drawn of Sagunto were shown at the Hotel Palace in Madrid, together with other works by architects who studied and drew ancient Spanish Roman cities. In addition to those by Muguruza, those by Baltasar Hernández Briz on Tarragona were also shown, as well as those by Gustavo Fernández Balbuena on Itálica (García Mercadal 1917, 5).

Muguruza entered these two competitions one year before finishing the university course. The judgement for the final project was held on 30th September, 1916, and the jury was made up of Manuel Aníbal Álvarez, Alberto Albiñana and Vicente Lampérez. The exercise involved the following procedure: the students had 12 h to do the sketch and two and a half months to carry out the project. For this exercise, Muguruza depicted an isolated pavilion for the royal pier in La Magdalena, Santander.[2] This was graded as outstanding, earning him the degree in architecture in December that same year.

Two illustrations for his final exam have been found, published in the journal *Arquitectura y Construcción*. One can see they are conceptually different from one another and they seem to play on the idea of a general view and a detailed view.

[1]DÍAZ IBARGOITIA, María: "*Dibujos de arquitectura premiados por el Círculo de Bellas Artes en 1915*" ("Drawings of Architecture given awards by the Fine Arts Circle in 1915"), *Archivo Español del Arte*, LXXXI, 321, 2008, pp. 67–76.

[2]"*Enseñanza profesional*" ("Professional teaching"), *Arquitectura y Construcción*, 1917, p. 200.

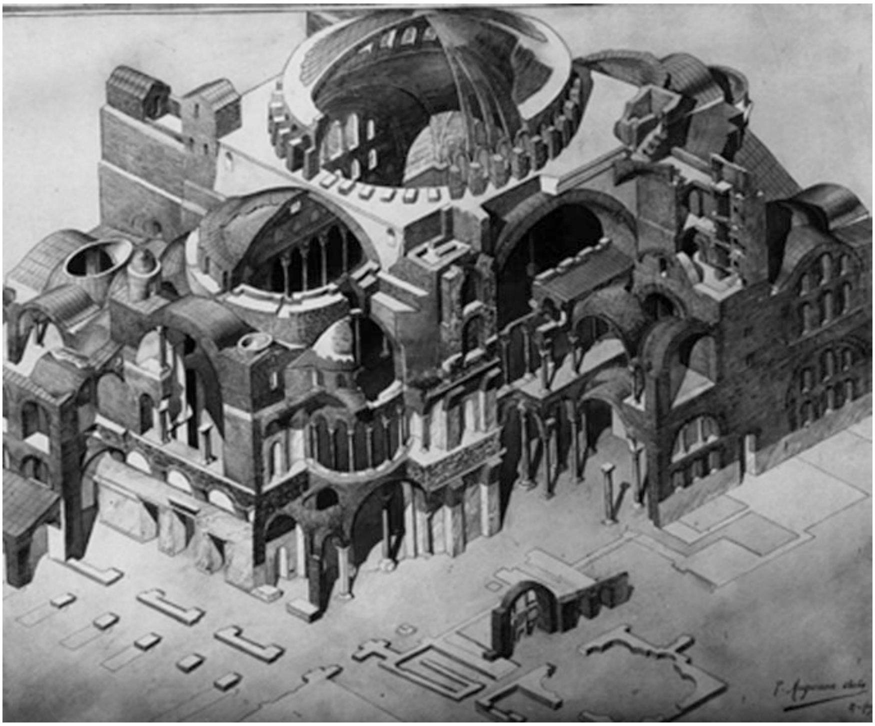

Fig. 1 P. Muguruza: axonometric cross section of Hagia Sophia of Constantinople, 1913 (AGA)

One shows an atmospheric, diffuse drawing (Fig. 3), with a sketch of the stairs in the foreground and in the diagonal the pergola obliquely in *escorzo*, where he included two figures that give the image scale. This sheet was done in wax, a technique to which Muguruza often resorted and which he also used in some of the drawings of Sagunto. Figure 4 shows an angle of the pier, a drawing that reflects a solid, stony and ornamental architecture, with *horror vacui*, where the student playfully represented textures and details.

On comparing Muguruza's two sheets with the same exercise by his colleagues Antonio Illanes del Río (1883–1973) and Francisco Javier Ferrero y Llusiá (1891–1936) (Fig. 5), one can seen that they are similar in using the same eclectic language and the same codes of representation. All of them tend towards graphic virtuosity more than demonstrating the precise tools of an architectural project.

In a short time, Muguruza went from student to teacher at the Madrid School of Architecture. Under recommendation from the director at that time, Ricardo Velázquez Bosco, he was named assistant lecturer in November, 1917. At the same time, now as a professional, that year Muguruza carried out the project (not built) for the reconstruction of the San Jéronimo El Real cloister in Madrid (Fig. 6), whose drawings reveal the influence of Lampérez and the historicist trend of the time.

Fig. 2 P. Muguruza: study for the Roman city of Sagunto, 1915 (in *Cien Dibujos*)

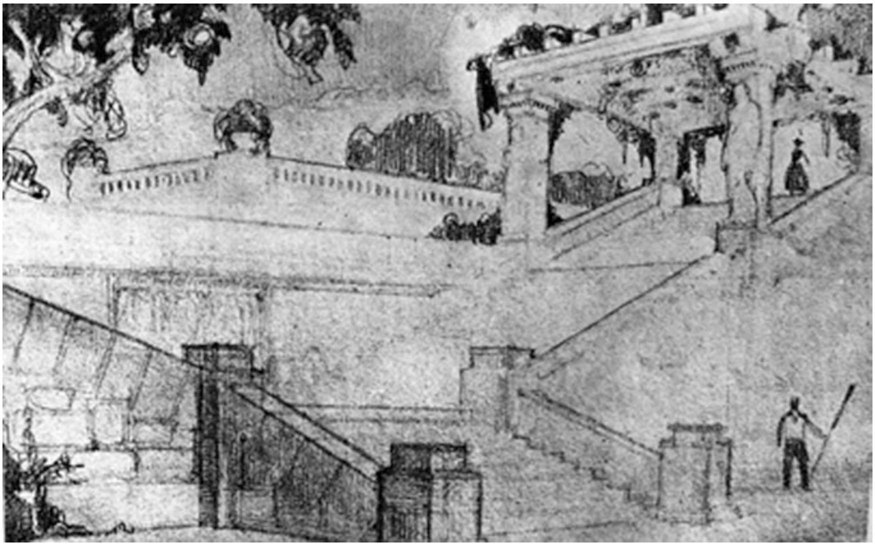

Fig. 3 P. Muguruza: final exam exercise, project of the royal pier in Santander, 1916 (in *Arquitectura y Construcción*, 1917)

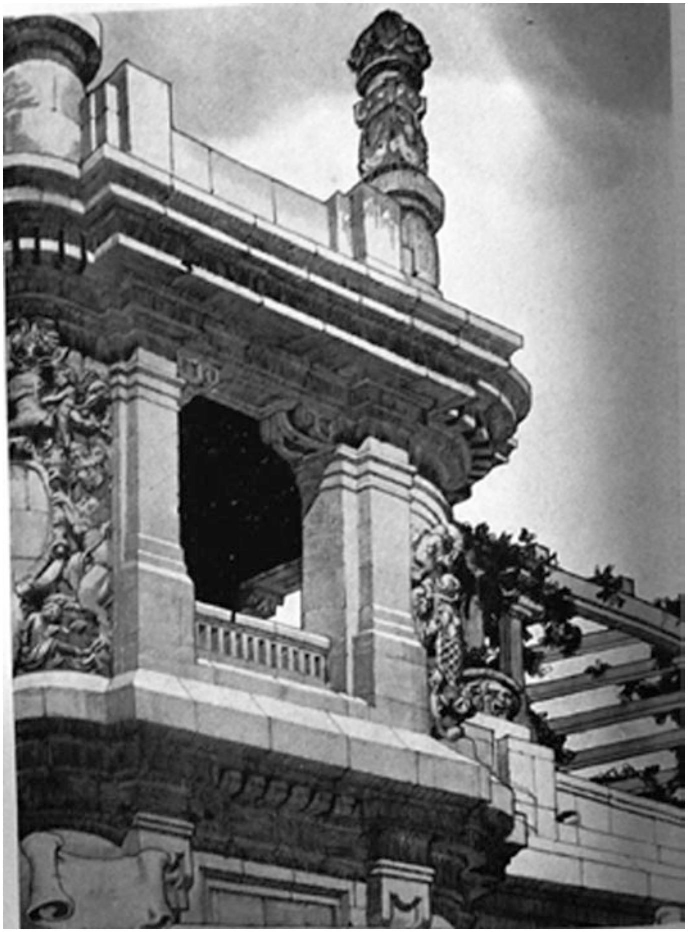

Fig. 4 Muguruza: final exam exercise, project of the royal pier in Santander, 1916 (in *Arquitectura y Construcción*, 1917)

A short time after, in 1920, Muguruza passed the entry exams to take on the professorship of "Projects of architectural and decorative details". In doing so he became part of the body teaching the subject in the second academic year of the syllabus for 1914. This was the first teaching syllabus of the 20th century for the Madrid School of Architecture. The intention with the new syllabus was to renew the discipline (García-Gutiérrez 2008) and in doing so attempt to bring real problems from the profession in practice into the university world. The system for access and the subjects were modified compared to the previous syllabus. Among the changes made, one aspect of the new methods was the introduction of a field study trip as a significant part of the programme, in an aim to make natural drawing a basic tool for understanding and assimilating architecture. In practice, this

Fig. 5 Javier Ferrero y Llusiá: final exam exercise, project for the royal pier in Santander, 1916 (in *Arquitectura y Construcción*, 1917)

Fig. 6 Perspective of a project for the San Jerónimo cloister in Madrid, 1917 (in *Cien dibujos*)

involved the teacher travelling with a group of students to study and get to know specific buildings and regions and thus discover the architectural reality outside the classroom.

One of these trips for which Muguruza was responsible was an excursion to Murcia made in April, 1926, with the school's final year students. The lecturer's drawings were published in the journal *Arquitectura Española* (Muguruza Otaño 1927), a publication to which this architect often contributed. These documents reveal his interest in showing the facades and construction systems of the baroque examples that they studied, used as a means of analysis and understanding, where eaves, exploded drawings and other elements were drawn in order to capture their shape and function (Fig. 7).

Fig. 7 P. Muguruza: drawing of the old Royal Silk Factory in Murcia (in *Arquitectura Española*, 1927)

As a lecturer in the Madrid School of Architecture, Muguruza received students who had passed the first academic year of projects, taught by López Otero and called "Copying Architectural Ensembles". After his subject, they studied "Ensemble Projects" taught by Pascual Bravo. Out of the three, it was this latter lecturer who most reflected upon teaching, and this was the topic of his entrance speech into the San Fernando School of Fine Arts, where he took up the post that his colleague Muguruza vacated in 1952.

The three subjects in Projects were then called the "three drawing courses: pieces, details and ensembles" (Moya 1964, 47). The aim of these was to develop the students' artistic education, acquiring formal and compositional ideas that did not arise from questions of numbers, calculation and structures; in other words, creating projects from the most graphical and creative point of view. These were the subjects with which it was intended to convey to the students the necessary tools to address architectural works in their creative essence, fostering taste, imagination and originality; in short, stimulating the university students' concerns (Bravo 1954, 20). In order for the students to get the most out of these three subjects, Pascual Bravo highlighted the importance of how the teacher should present all that the project demanded in the most suitable way; in other words, the definition of the essential elements that were to comprise it, the relationship between services and matching their form to their function (Bravo 1931).

In spite of the efforts made to overhaul the system of education, the introduction of the 1914 syllabus also brought with it some criticism. In this regard, a controversial debate and reflection arose about the teaching of architecture, with Antonio Flórez and Teodoro Anasagasti becoming particular prominent. Both of them denounced the routine, anti-pedagogical system, and they detected that the 1914 syllabus repeated the previous mistakes such as an insistence on theory and being too far removed from practice. The teaching mechanisms were also labelled as backward in the journal *A.C.*, in which the following comment was published:

> En las Escuelas Superiores de Arquitectura se lleva a cabo la enseñanza por un medio mal llamado 'académico' y nosotros creemos que semejante enseñanza 'académica' tiene que desprenderse rápidamente de cuanto significa interés arqueológico, para adaptarse y propagar los procedimientos que hoy día constituyen el eje de la actual arquitectura; procedimientos con vida de hoy, que pueden servirnos de guía en el proceso evolutivo del momento actual.[3]

The 1914 syllabus was in use for twenty years and was replaced by the 1934 one. The subject for which Muguruza was a professor which came to be taught in the first academic year was called "Architectural Details and Ensembles and their application in ornamental composition". However, in this case the architect did not take part in teaching it, since in 1932 he requested a few months of sick leave that turned into years of voluntary leave to attend to specific matters.[4] This parenthesis

[3]"*En las Escuelas Superiores de Arquitectura*" ("In the Higher Schools of Architecture"), *A. C.*, no. 4, 1931, p. 15.

[4]*Gaceta de Madrid*, 21st January and 1st November, 1932; ETSAM, 17th January, 1938.

in his teaching activity stretched out until January, 1938, when he applied to return, with the Civil War raging, to the teaching staff.[5] Once again, Muguruza did not carry out this activity. When the war ended he was appointed as the first Director General of Architecture, a post that demanded frequent travel and a great deal of dedication. He became a political architect, a public figure dedicated to the collective cause of institutionalising the profession in the new state.

In the post-war period, the teaching of architecture continued to raise discussion and debate. In this context, an attempt was made to define the official model of teaching, which in Spain at the time was still based on traditional dogmatism, founded on an academic system in which the survival of historicism predominated (Sáinz de los Terreros 1944) (Fig. 8). Some ideas about the educational system were put forward in the National Assemblies of Architects, which he himself chaired until 1946. There, Muguruza explained his opposition to the disparity in criteria between the Schools of Architecture in Spain. In this regard, with his characteristic attitude in favour of centralization [towards Madrid], he believed it was necessary to establish some national guidelines (Muguruza Otaño 1941, 137).

The next piece of information known about Muguruza's teaching activity is to be found in September, 1946, when he stopped working at the General Directorate of Architecture (Muguruza 1939). He then applied to enter the activity of teaching again, while at the same time managing the change of subject. In his last years as a professor he did not teach Projects, but occupied the professorship in two subjects for the fourth and fifth academic years, "Health and Hygiene in Buildings in Towns" and "Urbanology".[6] This fact is significant since it indicates the change of scale and interests that came about in the latter period of his professional activity.

Within the documentation found on Muguruza's teaching side, there is a lack of personal testimonials such as a diary or report on the courses by Muguruza himself. The matter can be studied via the administrative reports still preserved, the specialised journals of the time and from some anecdotes told by his colleagues. Muguruza was one of those teachers that insisted upon the need to bring theory closer to practice, wanting to put an end to the separation between the teachings and the profession. One example that demonstrates this appears in the forties, when he considered it convenient for those who had recently graduated to have a compulsory period of training in official bodies that covered the discipline, thereby putting into practice the knowledge acquired in class.

Muguruza was one of the teachers who stood out in the history of the Madrid School of Architecture. He was a teacher to some of the architects of the so-called "Generation of '25": Fernández Shaw (graduated 1919), Lacasa (g. 1921), Sánchez Arcas (g. 1921), García Mercadal (g. 1921), teacher to Gutiérrez Soto (g. 1923), who remembered him as "that unforgettable teacher and cordial friend" (VV.AA 1978, 15; Gutiérrez Soto 1960). Muguruza was a contemporary to one of the periods of reflection about professional teaching of the discipline. On his death in

[5]ETSAM (Madrid School of Architecture) archive.

[6]ETSAM archive, 6th November, 1946.

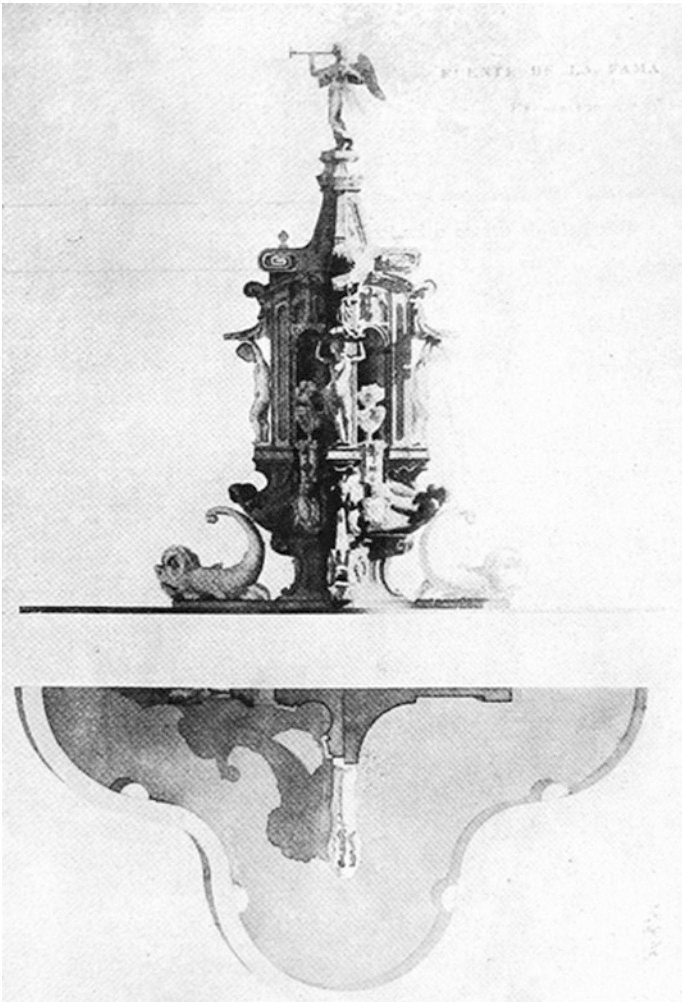

Fig. 8 *Fuente de la Fama*, work by the student from the first year at the Madrid Higher School of Architecture, in the class "Drawing of architectural details and ensembles" (in *RNA*, 1994)

February, 1952, as Pascual Bravo explained (Bravo 1952), the Madrid School of Architecture named a lecture theatre after him and a commemorative event was held accompanied by an exhibition of his drawings.

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The Playful Aspect of the Architectural Model. Notes Explaining Its Survival Over Time

Eduardo Carazo Lefort

> *My career started when I was a child and I built my first sandcastle on the beach in Genoa, where I grew up. Making things has always been a pleasure for me—happy hands, happy mind—and making sandcastles was my training in fantasy. Now, as an architect constructing buildings like the Shard, I have to think about the final result, but as a child making castles of sand I didn't, they were ephemeral.*
> Renzo Piano. "How to build the perfect sandcastle". *The guardian*, 14/07/2015. http://www.theguardian.com/lifeandstyle/2015/jul/14/sandcastle-beach-renzo-piano-shardarchitect-build, visit 15/08/2015

Abstract This paper studies the model of architecture and its survival over time, even today, in competition with infographic representation systems. To do this, in a series of letters in which the author has previously published several aspects that justify the survival of the model, we intend now to explore the playful aspect of these small objects. Some of the theories about the game in relation to culture and art, to then apply them to the alleged relationship between model and play.

Keyword Play · Architectural model

1 Introduction

The thousand year history of *the architecture as a job* (Grassi 1980) has evolved into a wide landscape of shapes and technologies; however, this landscape has not been particularly varied, as something as substantial for the profession as ways of architectural *representation.* In this regard we can confirm that expression of ideas or architectural forms has been considerable since the ancient times of architecture (Kostof 1984) (Fig. 1).

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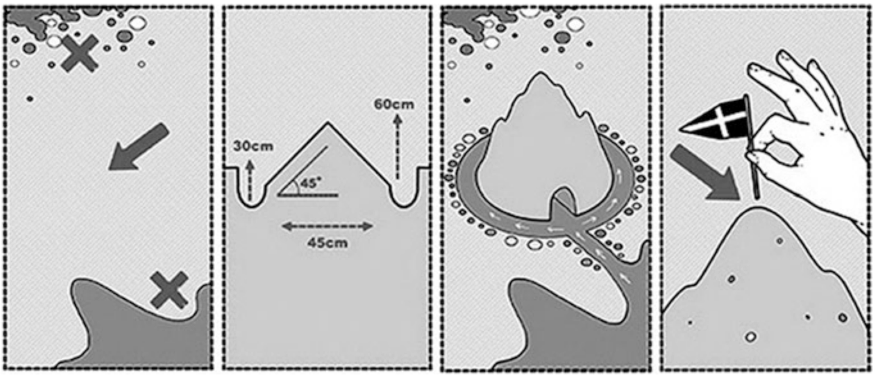

Fig. 1 *How to build the perfect sandcastle. Ilustración de Son of Alan. The guardian*, 14/07/2015

We can therefore recognise our own methods of contemporary representation in such things as the process of creating floors in Egyptian temples (Cabezas 1994), even though it could be argued that now these floors are "vectors" or that they form part of a departure from a three dimensional virtual design, what is certain however is that a building is still built from the floor upwards. Perhaps the invention of axonometric design by French engineers in the 18th century could be understood as a substantial change of graphic systems, which has recently seen a supposed breakthrough in infographic representation systems.

Despite the important revolution in global architectural representation generated by the media (Uría 2007), there is a procedure which has endured through hell and high water, as a mechanism which is especially useful in representing the different realities of architectural fact: the model or scale model (Carazo Lefort 2010, 2011, 2014).

This therefore begs the question, why such a persistent and unrelenting survival, from the precious ritual models found in Egyptian tombs,[1] up to current models and objects produced by some of the most important modern day architects offices,—and this is relevant in this context—due to the huge production of models in all architecture schools around the world.

Much like the almost *Darwinian* survival of these strange objects, they themselves can never truly be understood due to a unique factor, though many other factors have been repeatedly proffered and studied. Here we will try to explore to what extent the innate and anthropological instinct of *Homo Ludens* (Huizinga 1938) can also be cause for the continuity and survival of the architectural model. The aim of the paper is therefore to explore the aspects of production, conservation and view of the models, as intertwined as they are analysed: within the playful

[1]Gentil (1998, 15). "…He forgets often that nothing reaches the symbol category without having been an everyday object".

aspect, which is integral to these things. It is about offering up an idea which is not only about the model as a *game*, but also as a *toy*.

2 Theories on the Playful Aspect

Since Johan Huizinga published his theory on games being applied to the most important human activities—culture, competition, law, war, knowledge, poetry, philosophy, art and music—we have learnt to consider the game not only as something for children but as an activity that intertwines our social behaviour with high levels of seriousness: but, above all, as a determining factor of many cultural events. E.H. Gombrich therefore, maintains, "*homo faber* must be associated with *homo ludens*, the man who enjoys games" (Gombrich 1980, 217).

It is claimed that the sense of a game—as a *sense of order,* stated by Gombrich as a hypothesis of his theory of decorative arts—could constitute an attitude which is integral to the human condition itself, something like this as a basic instinct of said condition. Therefore if we could maintain this theory, it would not be hard to venture that the model, as an playful object—if we test such a condition—supported in the last instance by one of our anthropological conditions, what we could consequently explain from this point of view, is its attraction, and therefore one of the reasons for its current survival amongst all kinds of digital artefacts.

However, the concept of the game with regard to its place in culture and art has not been sufficiently explored, despite some relevant authors having dedicated several studies to this concept. We can in fact distinguish the game from other activities—from "the serious"—, and it would also be possible to state some of its other characteristics, despite it not being so easy to arrive at a clear definition of these. What is more, given its multifaceted influence, the game has tried to define itself within different disciplines, such as psychology, teaching, sociology or anthropology, among others, but it hasn't reached a unanimous agreement in that respect.

Etymologically, we can highlight the Greek concepts of "pradeia"—as spontaneous expressions of the game—and "agón"—as competition—(Huizinga 1938, 43–62); and in Latin, we have the expression "ludus"; which encompasses all activities that we know within the game, a word which in turn is derived from the Latin "iocari"—related to the idea of a joke or jest—.

For Huizinga, the pioneer of studies of this concept, culture in general is susceptible to being analysed "*sub specie ludi*". Therefore, it defines a series of conditions that are integral to the game, understood in his studies as an unavoidable trigger factor of cultural events. Special mention must be made about the conditions, which contribute, if not to establishing a definition of the game in art, then in clarifying its involvement in the effects that we claim.

The first of these conditions or characteristics of the game is it's integral *liberty*: the game is a *free activity* and is impartial; it is played voluntarily. Secondly it is worth noting the idea of *microcosms*: the game is an activity that is conducted outside of daily life. It is conducted "as if", and it becomes a *representation*, which is also liable to be *repeated* successively. Thirdly, the game *is not purpose based*, it does not have an ending, it is played for the sake of playing, and does not bear any rewards or have posterior benefits.[2] Fourthly the *limitation* of the game should be highlighted: it is played within time and space limits. Fifthly, the subjection to a set of *rules*, accepted by people in their social surrounding-apart from killjoys, but not cheats, who despite their violation of these rules, pretend to accept them—. This all implies then, that the game requires, in order for it to develop, a high level of *seriousness*.

Roger Callois[3] expressed similar ideas, also defining the game as something inherent to culture, understanding this as something inseparable from social life in its group, while the most complex manifestations of society tend to appear intertwined with playful structures, therefore following distinguishable patterns from within the characteristics of the game.

Such characteristics are also those of *Liberty*, for both Caillois and Huizinga—the game is played freely—*separation* from real life—space and time limitations on the game activity—, *uncertainty*—in the result of the game, which cannot be predicted beforehand—, *unproductivity*—the game is not played to obtain specific benefits—, *rules*—subjugating to pre-established rules—, *fiction*—the activity is an action that is separate from real life, the 'as if' of Huizinga—.

In any case, and as a final point, in this brief and simple summary of some of the playful aspects, the *universal character* of the game should also be highlighted: it is and has always been played in all cultures in all locations and throughout all periods of time. What is more, the game transcends the barriers of anthropological studies, extending even to diverse characteristics of the animal kingdom.

3 The Game as a Learning Process

If it is certain that the game is present in all aspects of culture, to the point at which it characterises it, its importance as a learning process cannot be clearer, as has been shown previously by both Rosseau ([1762] 1821) and Piaget ([1945] 1984). In fact, Piaget believes that from the age of one a child's capacity for the so-called *construction game*, which consists of a group of actions such as fitting, stacking and classifying. This means that any activity involving using your hands is already coordinated by the eye and brain, and is carried out with three-dimensional physical objects. These activities are help to form patterns of order and are susceptible to being repeated. The child enjoys expressly during the process—*happy hands,*

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[2]This unproductive game and autonomy, are also highlighted by Yutang (1943).

[3]Caillois (1958). Caillois [1958] (1994). Caillois clarifies and deepens the theories enunciated by Huizinga twenty years ago, raising interesting classifications of the types of games, and understanding them from various angles in the culture, although the critical comparison between the theories of both authors goes far beyond the possibilities of this writing.

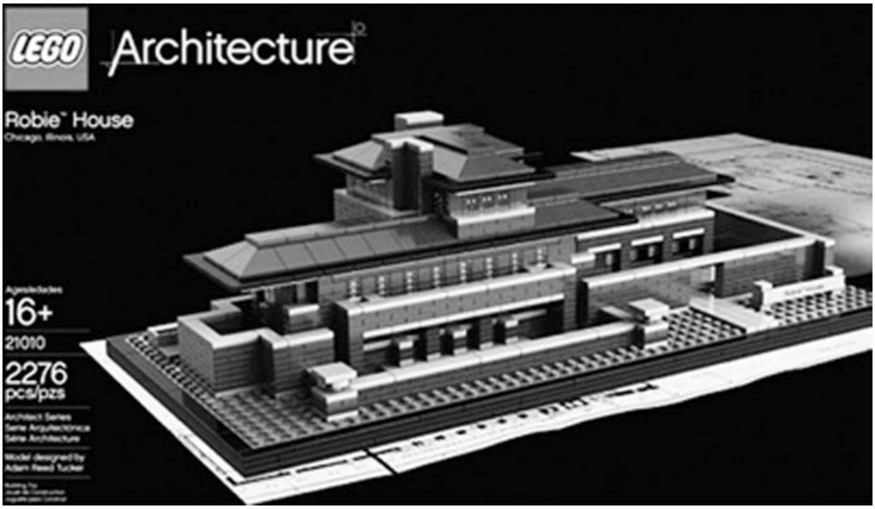

Fig. 2 Lego architecture. Robie House F. Ll. Wright

happy mind—. In this activity we see a lot of the characteristics previously attributed to the game.

In these educational models, many figurative scale elements appear in several cases, which maintain an accurate reference—normally sifting through to the most iconic—with its respective models of reality. In it's handling, its domain, but also in its value as a representation of everyday objects, these toys help to discover their educational capabilities, and therefore their value. From them they derive traditional toys, like all kinds of scale models of humans and animals, vehicles, buildings etc., that are more special than other stages of child development, which are however also present in many activities in adult life (Fig. 2).

If we explore subjects that have been studied profusely within sociology, we can understand the intense intertwining of the representational games in personality development, and finally in the creation of societies; however all of this, without detriment to its current obsolescence in favour of the games,—also of representation—generated by the digital industry, all of this, would allow us to explain the relation that we try to understand, between model, game and toy, which we will come back to.

Before that, we can briefly review the importance of models in the educational system within teaching architecture in light of the ideas we have put forward, a subject of importance for the line of argument that we present, and for the context of this contribution.

Firstly, in relation to Huizinga's statement, about the game being a *representation*. In fact, teaching architecture, and in particular that which is relative to the "workshop" subjects which come directly from the essence of Technical Schools—facing universities—, is based on the model of fiction, which ultimately, is a kind of

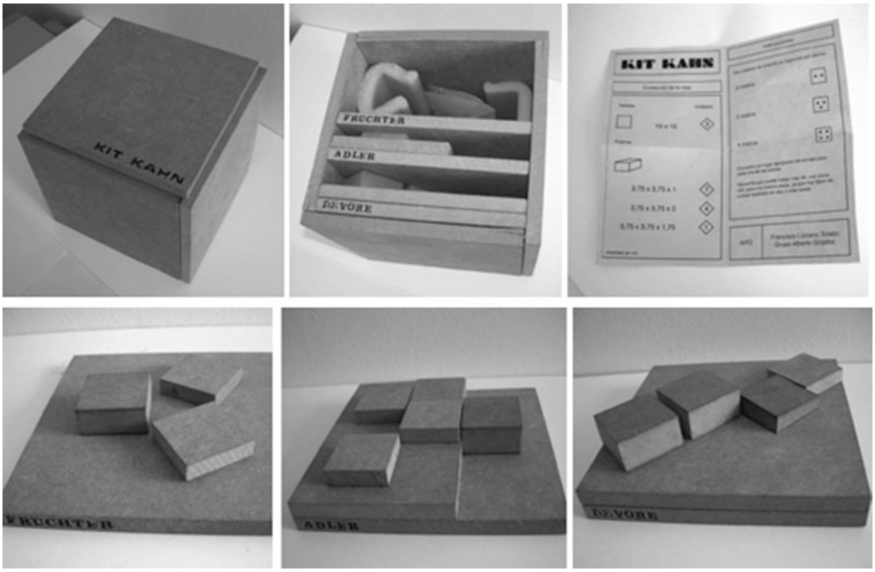

Fig. 3 Scale model of academic work of the subject "Análisis de Formas". E.T.S. de Arquitectura de Valladolid

game, as it is a representation. We make students believe in "doing" projects; in "constructing"—despite it only being a case of designing in reality—constructive systems and elements; which a load bearing structure—designed—can hold strong or fall; and this fiction—a necessary fictitious representation of the "real" world—is maintained by convention, and therefore has rules and a high level of seriousness.

In a paper related to end of degree projects, something which this writer remembers well, if that wasn't clear already, "fiction of representation", the illusion that design generates as a codified system of representation, means that even before the student creates their project, it is "almost" already a "reality".[4]

Secondly with the theories of Piaget related to the game as an educational mechanism and especially his theory of "constructivist" education. In a recent paper, we analysed the interest of small models—models that "fit in the palm of your hand"—for teaching analysis. In this context it should be mentioned that some of these models, have the abstract nature of a three-dimensional diagram that revolves around the domain of a game or a toy. This means that, they make their educational proposal, and turn the game into an analytical process of architecture (Fig. 3).

This presents in an open way the relations we are trying to establish, without damaging other objects, other models, all models, which contain a playful element, albeit not such an evident one.

[4]AA. VV. (2008, 9).

4 Objects of the Game

In this context, the opening quote of this paper is of key relevance, as the valuation of something as seemingly banal as sandcastles by an internationally renowned architect is not fortuitous. Sandcastles undoubtedly offer an example model; not only as they really do offer a scale model representation of a real castle; but also because of the construction materials, which are so dependent on the ephemeral. The materials determine its shape—apart from in the case of some displays with lucrative or competitive aims—and its location, in a particularly pleasant and banal place, reaffirms its playful element.

Furthermore, and following on from Piano, this also complies with other conditions highlighted by Huizinga that we have already expressed: they are made within strict limits, both physical—the beach—, and time—the tide—; they represent something—a castle; they can also have an agonistic nature; and obviously they are made without any productive interest, they are made simply for the pleasure of making them—*happy hands, happy mind*—. But when the tide comes in, the game ends. Immediately.

This temporary nature, this brief existence is shared by the sandcastle with things known as ephemeral architecture, which in its frequently symbolic nature, as a fictitious representation of the permanent, also has aspects of the game and of the toy; in as much as they are nothing other than the product of assumed convention, of rules which belong as much to the event as those who do the activity do to the location, later rendering itself useless. We can admittedly look back to objects such as theatrical looms, as well as decorations and models from the pre digital film industry, triumphal arches and urban adornments that are so characteristic of the 19th century, and on a less disciplinary and more specifically festive level—playful—satirical representations of social reality with a recognised artistic element, much like the Fallas festival in Valencia.

Following this playful aspect of *representation*—"the game is a fight for something or a representation of something. Both functions can be merged with luck that the game represents a fight for something or a struggle to see who produces something the best" (Huzinga [1938] 2000, 27)—, we can remember an episode that has been reproduced and known, we should not snub it in this context. I am referring to fancy dress as a paradigm of the world of fiction and representation; and in particular, the topical image of the Halloween outfits worn by New York architects in 1931.[5]

As it is known, at the party organised by the society of Beaux arts Architects, just like its French namesake, some of the most relevant New York architects of the time, used a kind of model of their own buildings cleverly positioned atop their heads, along with outfits that were later considered as ridiculous attire which bore window pane designs, in an attempt to continue the facades of the buildings (Fig. 4).

[5]From left to right: Stewart Walker (Fuller Building), Leonard Schultze (Waldorf-Astoria), Ely Jacques Kahn (Squibb Building), William Van Alen (Chrysler Building), Ralph Walker (1 Wall Street), D.E. Ward (Metropolitan Tower) and Joseph H. Freelander (Museum of New York).

Fig. 4 New York architects disguised as their own buildings in 1931

In this case, the model, exempt of useful or professional content, is used as a representation of a building, but is applied to the anthropomorphic configuration of its creators. The model is a symbol—and this was not a new thing, it had been systematically used in the sacred iconography of this style—but it was also a game; in as much as it was fancy dress, allowing the wearer to distance themselves from the "real" world, within some rules, within a determined time and space—the duration of the party and the joke, and within its field of celebration—.

5 Playful Aspects of the Model

In general, all of the models have been historically considered as playful objects, to some extent. This "manual" characteristic nature of it and its "objecthood", have turned the model into an object that called out to be touched, to be handled and played with. This characteristic is currently exploited, for example in benefit of the cognitive capacity of blind people in relation to the three dimensional nature of architecture which, on scale is easy to apprehend.[6] At the same time this same characteristic has throughout history been the cause of its downfall. Few models in the history of architecture have arrived to us, and those that have, have been poorly preserved.

The model produced for competition in 1592 should be remembered—the agonistic version of the Huizinga game—for the finishing of the San Petronio de Bologna Cathedral, consisted, according to Arduino Arriguzzi, of models conserved in his own museum (Millon 1994, 57).[7] The model, made from wood, which shows the full scale of the cathedral, and can be opened up to show the interior design of the building, it is sat on a base also made from wood with a notice in which has the famous and limited evangelical phrase[8] in latin "noli me tagere", *do not touch me* (Fig. 5).

The competitions are another aspect that could lead from the model to the playful aspect, considering the most emphasised definition of the term by Huizinga, the game as a competition. In the competition, we can without doubt find architecture in its element (Grijalba and Ubeda 2012), and for the competition the model has been and is admittedly one of the best instruments of competition. However, we are not looking to go to far into this aspect here, though it clearly requires special attention in the future.

Another highly relevant issue within this theme is that of scale. The model, in terms of three-dimensional representation of architecture, is determined by scale, which means by the numeric relation between size of it in comparison to the original; the model, from existing architecture or projected, is always *representation*, never original. Although it is not possible in this paper to delve into such a broad issue—and not particularly studied from the conceptual point—, if finishing with a few reflections in this regard, which serve to present at least the relation that we are looking for with the playful aspect.

It is precisely within the scale where the model most acquires its condition as a game. This is how it is with regard to games—in the phase known as *construction* by Piaget ([1945] 1984)—frequently uses the scale as a key factor.[9] The scale is a well-known myth from playful episodes, like the well-known story from 1726 published as a novel by Jonathan Swift entitled *Gulliver's Travels*; and also the well

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[6]National Organization of the Blind of Spain (ONCE) Museo Tiflológico, Madrid. http://museo.once.es/home.cfm?id=1&nivel=1 visit 18/09/2015. Although there are many other examples of such models for the blind, such as the archaeological park of L'Almoina in Valencia, bronze and explanations in Braille (Model L'Almoina by Manuel Real molten bronze by Jaume Espí sculptor). https://www.facebook.com/media/set/?set=a.589432977738839.156761.479128158769322&type=3.

[7]San Petronio Museum, Bolognia, Italy, cat. 151.

[8]Verse 17 of Chap. 20 of the Gospel of John.

[9]It seems conceivable that the child scale reduction of certain agricultural instruments, children that prehistoric collection should help the group or tribe, may be the origin of this idea as something that plays toy or represents a larger object and by virtue of its scale reduction it is more affordable or manipulated by small hands.

Fig. 5 Scale model of the Cathedral San Petronio at Bologna. Museo di San Petronio, Cat. n. 151

known paradigmatic model-toy known as a “doll’s house”, a long tradition in western society (Fig. 6).

The playful aspect of the model is admittedly most palpable in edible models that, Gentil describes (1998, 47–48 and nn. 70 and 71). The marzipan models of

Fig. 6 Dollhouse, year 1611, Germanisches Nationalmuseum, Nuremberg

Leonardo da Vinci, which the Duke of Milan' courtiers devoured much to the disapproval of the artist, who hadn't built them for that purpose. Or the most outrageous gastronomic parties of the so-called *Compagnia del Paiuolo*—the cauldron company—where on occasion Andrea del Sarto (h. 1487–h. 1531) presented to his peers, Florentine artists, a model of the central space of a temple, surrounded by columns made of sausage, with capitals made of parmesan, and a plethora of other culinary ingredients which turned the model into a focal point of the party, and therefore the game.

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Author Biography

Eduardo Carazo Lefort Full Professor of Architectural Drawing at the E.T.S. of Architecture at the *Universidad de Valladolid.* The lines of investigation in the presented paper refer to modes of representation within Architecture, with special focus on the model, both physical and virtual; Likewise he has produced several works on graphic analysis and infographic restoration of urban heritage in historic towns such as Valladolid, Oporto, Zamora, Ávila and Oviedo, on some of which he has produced Doctoral Theses and published several articles and given talks at conferences. His last monography was published in 2010 under the title Valladolid, Forma Urbis.

Perception, Drawing, Knowledge

Lia Maria Papa, Giuseppe Antuono and Francesco Pepe

Abstract The relationship between drawing and knowledge lends itself today renovated evaluations and methodological questions brought by the rapid and continuous expansion of new technologies. This paper discusses some educational activities and different ways of methodological approach introduced recently, as part of the drawing lessons of the Studies Course of Department of Civil, Architectural and Environmental Engineering, Polytechnic School of Basic Sciences of Naples, with the intent to strengthen the awareness that the instrumental innovations, full of new applications and bearers of rightful methodological revisions, do not modify rather emphasize the conscious exercise to relate the eye, the hand and the mind, as an inevitable stage of training during the course of progressive understanding/knowledge of the space and the relationship between object and context.

Keywords Drawing · Language · Perception · Techniques

1 Designing Teaching: A Two Way Street[1]

The verb "design" derives from *desĭgnare*, that is *signare* with the prefix *de* and it means to represent imaginary or real things by means of signs, but it also means a purpose, intention.

[1]L.M. Papa developed the first part of the contribution, with the first two paragraphs.

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Both *designare (design)* and *insegnare (teach)* are linked to the noun *signum*, which means exactly that, a sign, a signet.

Actually the verb *insegnare (to teach)* derives from the Latin *insignare*, composed from the prefix *in* united with the verb *signare*, with the meaning of indicating, impressing, or even *forming signs,* and defining them in their orderly form, delivering them to others, assigning to each user the type of indications whose development is perceived as best matching the educational development or a concrete utilization.

Therefore, whoever teaches, instead of merely transmitting the knowledge for its own sake, *marks* the student's mind, imprinting a method of approaching reality, which goes far beyond study.

The system of signs is a language itself, in whichever form it is configured. The signs are those which *designate a meaning*: these presume mental designs, including projects, which tend to assume a communicable form, by means of essential sketches, which are kept together by signs.

Therefore, this proves the essential reciprocity between *designing* and *teaching.*

Image is essential in every form of language and teaching: it is essential as much as the concept itself. Conceptual languages and imagebased languages are not set against one another; in fact, they tend to integrate and enrich one another. The most common examples make up the modes of the so called scientific communication, for example, in graphic forms and illustrations, where texts and images are supposed to cement the cognitive structures shared between the sender and the receiver.

In the delicate phase of engineer or architect training, one must keep in mind the different cultural background of students, the intrinsic features of each of the methods used, the historical and cultural characteristics that differentiate them all, and the different uses it can be put to.

One of the most frequent errors made is mistaking a product or single action characteristics with the characteristics of the process.

The relation between design and knowledge represents the fundamental motive of every informed reflection upon the role of design, which has offered in time a fertile ground for thought to illustrious scholars; today, methodology related questions are induced by the ever growing development of new technologies, by changed cultural and social needs, by the relative and necessary reinterpretations of disciplines done not only at the theoretical level, but at the practical level of representative activities as well, with an intention of strengthening the awareness, among other, that the technological innovations, as much as they offer new applications and bring the needed notional revisions, do not alter, but on the contrary, properly emphasize and integrate the conscious practice of relating the eye, the hand and the mind, which is an unavoidable step in the course of progressive understanding/knowing of space and the relationship between the object and the context.

Designing means, above all, *seeing*, or becoming aware of one's own interior world made of memories, knowledge, as well as the external world towards which the former works as a filter, selecting among the perceived elements those to conserve and value and those to forget and set aside. That way, we develop the ability to perceive and confront over time perceptions and sensations, those present

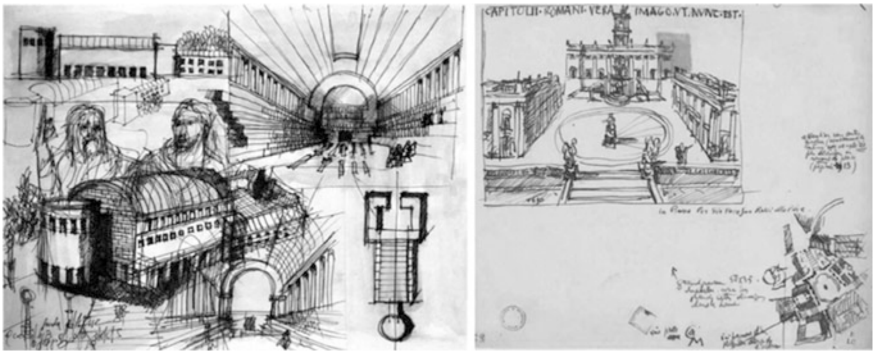

Fig. 1 *To the left* Aldo Rossi, Project for the new public library of Seregno, study sketch, 1989. *To the right* Le Corbusier. Drawing and sketch of the floor plan of the baptistery of San Giovanni at Siena, 1907

with the past ones, by means of a series of choices and actions whose intention is to develop a conscientious and solid ability to distinguish and to merge, to separate and to unite various perceptions, thus giving them, from one moment to the next, new forms, taking from their flowing nature stable and harmonious elements (Fig. 1).

2 The Road to Understanding Space: A Didactic Experiment (see Footnote 1)

The different forms of design and infinite formations of signs and symbols represent synthetic translations of mental images; primarily, they have a cognitive and communicative valence, even if they communicate the essence, the structure and the meaning of multiple concrete realities in a different way.

The need to communicate, to share in the different and diversified contexts of use, sometimes makes us observe some kind of redundancy of the however necessary technical rationality, characterized by "exact" languages, justifiably used in a strict, extended and universalized way. Actually, such languages, justified by the need to transmit objective information, are always symbolic; however, to different users, but above all in the educational courses, these must find new forms of alliances, of mutual integration between purely conventional signs, geometrically correct sketches and images, whose assigned meaning does not transmit a system of conventions, but is much more free and creative, thus having a strong communicative energy and efficiency.

In any historical period, the meaningful quality of a design comes from something that goes beyond the correct use of signs according to the norm, from something which searches, in the aware exception to the graphical rule and conscious overriding of the norm, the signs of the sense of one's own being and proves to be of what it represents.

For some years, in teaching Design in the three year course of study of Civil Engineering, and in the four year study, recognized at the European level, of Civil Engineering and Architecture of the Department of Civil and Environmental Engineering of the University of Naples, Federico II, training activities and the operational approach modes are carried out which aim at consolidating the methodological path that the student needs to take in the sense of knowledge—competences, increasing the awareness that interdisciplinary interactions, introduced from the first years of university studies, strengthen the student's education, and consequently, his/her capacity to integrate various types of know-how.

The first program, with experimental teaching significance, saw a *vertical* correlation between lessons taught in Civil Design and Architectural Composition courses, provided in the subsequent years, that is, in the first and second year of graduating from the Civil Engineering course. The specific goals and modes of action were described in the paper presented at the EGA 2016 Conference, signed by Pierpaolo d'Agostino and Maria Teresa Giammetti.

The second program, that we'll elaborate upon briefly, is implemented in the same training course, but in the *horizontal* correlation, thus building a fruitful comparison with other universities which, in the past two years, were the University of Rome La Sapienza and the University of Salerno, regarding the first year of the MA in Civil Engineering and Architecture course (Fig. 2).

Fig. 2 Presentation of the two training programs

Fig. 3 The steps of training courses between Naples and Salerno

The aim of the annual activity titled "*Workshop di Disegno a mano libera*" *(Free Hand Design Workshop)* is to promote those actions matching two different goals; the first aims at student's getting used to relating the eye, the mind and the hand to what was written above, developing the habit to see, beyond mere looking at, the concrete reality in order to seek in it composition rules, identifying proportion between the object and the context, comparing the perceived with images from one's own memory, becoming aware of the fact that design is identified as a privileged means for understanding both the inner world—made of memories, sensations, knowledge—and the outer world, towards which it works as a privileged tool for selecting, among the perceived elements, those to value and to communicate. Only by fixing time after time in every single design a certain form among the infinite number of forms is it actually possible to communicate, at least partially, the flow of perceptions, being aware and able to control their dimensions and to arrange them in a meaningful order. This is where various "*single accords between the soul, the eye and the hand*" are realized, described by Paul Valéry in his essays (Fig. 3).

The second, but not less important goal of the initiative is to motivate the student to develop a habit of comparing ideas and communication strategies, of teamwork, not only with colleagues they often see, but also, as in this case, the ones they see only occasionally, due to a particular training experience.

The students have actually performed their activities in both universities involved, accompanied and guided by a tutor; they were trained beforehand in general and disciplinary matters and performed field work of live drawing in an urban environment correlated to the first of the two university sites involved in the same academic year, while in the second university site they prepared an exhibition with a selection of their sketches and comments, which were produced by groups formed from students of both universities.

Although it can certainly be perfected, this experience is oriented towards providing concrete answers to the need for introducing, from the very first years, hybrid didactic forms, which allow developing/verifying the acquired sensibility, knowledge and competences, in a cognitive and conceptually united process.

3 Live Drawing as an Approach to Understanding Space[2]

Architectural notes, travel diaries, live sketches make up, as it is known, a common heritage of architects and engineers bridging the gap between the past centuries and our days. At the same time, it cannot be denied that today live drawing is an ever rarer cognitive tool both in working and in training environment: the focus is more shifted to technologically advanced approaches which replace the perceived reality and which have brought about the thinking that hand drawing is a mere outdated graphical activity. Along with this motive, derived from the ever less nourished habit starting from the secondary school, such training segment is sacrificed to the ever stricter needs that come from university teaching schedules.

Actually, live drawing is configured as a fundamental step in the course of understanding, controlling, and communicating space, which speaks with the project design and the descriptive geometry. With such conviction regarding the Workshop, preventive organization of the *extra moenia* activities is crucial, from the choice of place, which cannot be left to chance, along with a proper methodological approach in order to better guide the student in the first training steps, since perception causes different responses to stimuli that are confronted with individual sensibility and culture.

The chosen context was Mostra d'Oltremare of Naples, a spacious, prestigious area which harbors an architectonic, historical and environmental heritage of enormous value.

The task of *tutors* has also been defined in order to overcome the students' poor knowledge of history and geometries of its architecture, with a task of guiding the students in taking the existing interconnections between the elements that characterize the site, capturing its organizational structure, geometry and formal structure, without underestimating the study of stylistic elements and characters of the studied context, which are generally only observed in a superficial way.

The ability to understand the object in question is influenced justifiably by its position in an environment; so the graphical experience is repeated from different points of view and in different times of day. This allows us to notice those features that just a moment ago could not be observed.

In the seminar that preceded the field work the students were provided with useful pieces of information and suggestions regarding the work approach, the use of most appropriate graphical tool for getting the lines, if needed, of different width and softness, on a firm support, and depending on the type of paper, as well as the graphical techniques that could be used; actually, not of secondary importance are

[2]Giuseppe Antuono is the author of the third paragraph.

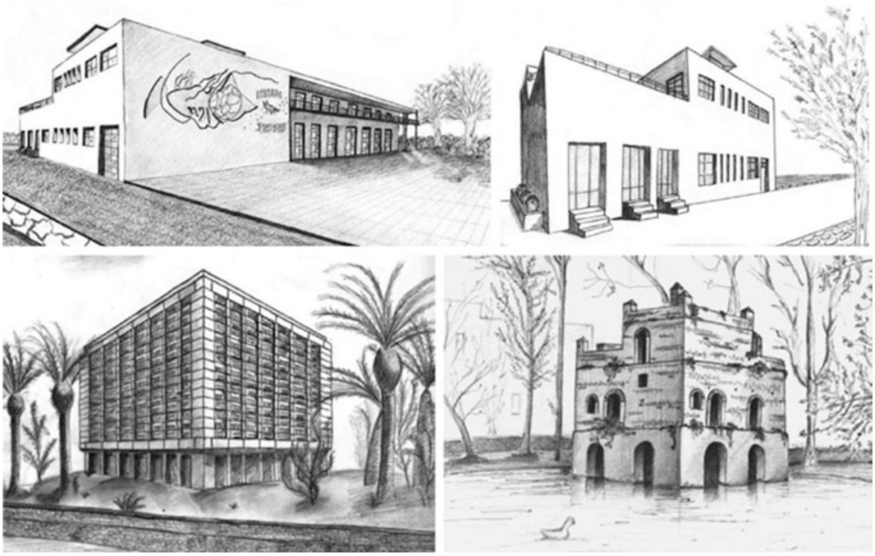

Fig. 4 Some student designs made in the course of field work during the Mostra d'Oltremare of Naples

all those choices (dashed, gradient, dotted, etc.) that influence the final result of the representation and which allow through the exercise to prove "*the true plastic force, a valid tendency to give body to the outline*".

The joint considerations necessarily made in the final balance, to which among other more space and training emphasis should be given, have proved, among other, a starting inclination of the student to use photo shoots not as a critical tool for deepening one's insight, but as a source of additional information, made to make the drawing look more similar to reality.

It seems obvious that applying project principles in live drawing allows for restoring ideally the object in the point of view from which the representation was made, for easily capturing the relations among different parts, on the one hand, while on the other it allows for disposing of the bases for a correct perspective setting, useful for defining and schematic discretization of the prevailing elements—the outline lines, the profile lines and angles—deriving from a synthetic reading (Fig. 4).

In the Renaissance, perspective helped consolidate the anthropocentric vision of architecture. Moreover, the Brunelleschi system confirms the "vision" as a central discourse in the architecture, the opinion that was held from the XVI century to our days. This means that, despite numerous changes of styles that occurred over time and despite many attempts at modifying such vision, the central position of the monocular beholder has always constituted a basic discourse term for the architectural foreshadowing and representation.

Despite the fact that the first drawings, quite diversified in terms of quality, generally show a less strict use of elements that determine the perspective, it helps the student in the process of discretization, in drawing that limited, but justified number of signs necessary for proving the chosen aspect of the observed reality, depending on individual sensibility.

It is obvious how a greater capacity of understanding space and the ability to use the graphical tool comes from repeated exercise; it follows a careful drawing even in describing the elements positioned at different distances from the beholder, pronounced by using the light and dark technique which highlights depth and spatial articulation of the scene. It follows a different expressive capacity, moving from one basic representation to the one richer in detail and particulars, diversifying also the pen strokes, from more decisive to more suave, depending on one's own capacity and level of depth.

Through reading the relationship between the parts and the elements in actual space, a mental model of the scene takes shape which is useful for foreshadowing and structuring the information, translating it, always by free hand, in planimetric, objective schemes, according to the rules of orthogonal representation.

In that way, live drawing is set as a basic step in understanding the geometry of forms and relationship among the parts, as a prelude to the technical representation, with its rules and conventions. This allows us to uncover, i.e. comprehend and understand; the important thing is to train the eye and the mind to the art of seeing, penetrating through the veil imposed by habit and consolidated interpretations.

4 Perceivable, Implementable. The Scale Model[3]

On the road to comprehending and controlling space, live drawing opens up a training course made of other steps. One of these is implementing a material scaled model of an object or its parts. The *maquette* has always been an excellent product made for comprehending spatial expression of foreshadowed or built objects, as a kit to traditional technical drawings.

Even Leon Battista Alberti in *De re edificatoria* supported the use of scaled material models of works, which would enable rework and critical revisiting of one's own project idea and at the same time pass them to the skilled workers. Obviously, such *modus operandi* permitted, and continues to permit even today, a strong formal control of the artifact, allowing for a breaking up of each of its parts in order to verify the forms and volumes, from the structure to the covers, depending on the materials used.

The Applied School of Naples, which later became the Faculty of Engineering, from the very beginning in 1811 has always given great didactic importance to the

[3]Francesco Pepe wrote the fourth.

making of the *maquette*, both the architectonic complex and its parts, making it a base for multidisciplinary considerations and elaboration.

However, thanks to the ever growing technological innovation, now it may seem that resorting to *maquettes* is obsolete and expensive, not only in terms of money, but also in terms of time, especially where virtual models and reconstructions from photographs continue to gain more and more importance.

Drifting away from the realistic contexts and critical perception and comprehension of their connotations, today students are attracted to the tools with better performances, but often incapable of passing perceptive stimuli and critical responses regarding the immediate correlation between volumes, between the inner and the outer, between the subject and the object, which favors in that sense the main limitations and difficulties for students. The plastic model makes it possible for students to familiarize themselves with the constituent volumes of architecture if necessary, in the following phases of free hand drawing and acquiring the graphical language of the technical type, for different designs depending on the method of representation used, even in the initial approach to the material plastic, thus consolidating the comprehension of the space-level plane relation (Fig. 5).

What is sought is not just the aesthetically precise presentation that, in other contexts, matters the most, as much as the ability to simulate efficiently the volumes and their structure, as well as the articulation of inner spaces. This is why students are enticed to work with relatively economical and easily workable materials.

Thanks to the communicative power of the model, the student is forced to reflect and retrace the phases that have led him/her to read the architectonic space and improve his/her knowledge of elements and relations that unite them; in building and breaking up a building in its levels, he/she has to follow in a way the constructive process that is in its base, in order to simulate a concrete reality.

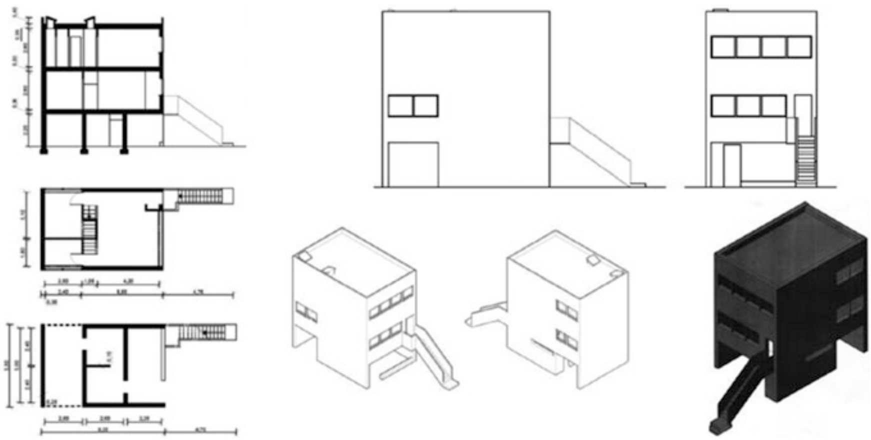

Fig. 5 CAD drawings made by students, from orthogonal representation to the digital model

The effort which is required is reading the alignments, symmetries, proportions and geometrical and mathematical schemes that are more difficult to understand, which supplement and become integral part of the data collected up until that moment by means of a sole natural vision and geometric-proportional planning.

Even though it is still taught, the practice of the scaled material model has undergone, as already mentioned, a significant change compared to the times when it was part of the didactic activity, aimed not only at understanding the geometry of forms, but also the structural behavior.

Without doubt, such path requires time which the current organization of studies often cannot accommodate. So, along with live drawing, even the *maquette* often appears as an unnecessary burden for the student, not transferred immediately to knowledge and detached from a cognitive chain.

Actually, implementation of the scaled model even allows for a better understanding of the subsequent, appropriate steps of virtual modeling. The computing platforms help consolidate the model more and more so that today, thanks to the use of parametric software, we are able to make changes to technical drawings and related virtual models relatively quickly.

In this sense, the classification that allows for interpretation and restoration of an object is articulated in two expressive forms whose purpose is to represent the objects according to a double code: on the one hand, the representation in orthogonal projections reserved for the definition of the proportional and metric system, and on the other hand, the iconic representation whose purpose is to harness the perceptive features; if the orthogonal projections serve to describe the space of an object, the perspective models efficiently describe the object in its space.

The images show this process exactly: the same *maquette* previously made in *carton plume,* and accompanied by graphics drawn according to the technical drawing conventions, was used as a base for digital modeling.

The use of a digital model benefits from extensive possibilities of modeling and use. The data may come directly from a laser scanner or from a series of photos taken in a certain data mode, that are oriented to obtain from them, with a proper software, a cloud of points which then, properly processed, undergo meshing.

From the very dawn of its invention, photography has always been considered a solution for "registering" reality; it is actually a privileged supporting means for analyzing the surfaces and for interpreting the form, the proportions and the measures of elements that make up an architectonic object.

Today, thanks to the advances in the information technology in the area of photogrammetry, geometric modeling and computational vision, the space of representation becomes definitely three-dimensional and photography represents one of the possible views of this space (Fig. 6).

In fact, photo modeling introduces an area of work which allows for the three-dimensional restoration of buildings based on global integration and in line with the phases of relief, modeling and representation. This consists in extracting all necessary information from the photographs in these different phases: coordinates, distances, characteristic points for the two-dimensional restoration of plans and

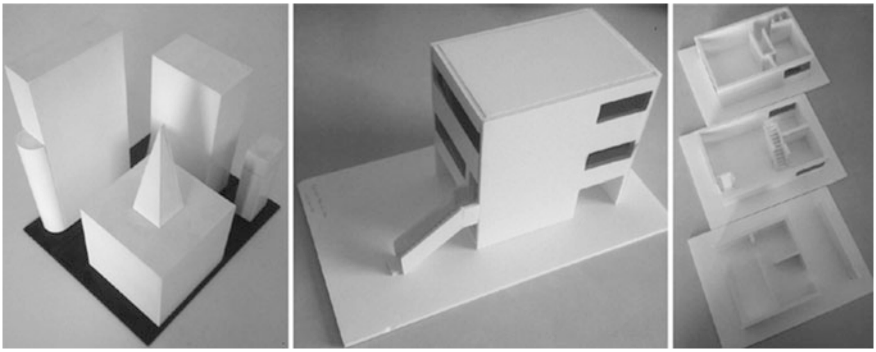

Fig. 6 Plastic figures made by students of the course Architectural Design I (prof. Lia M. Papa) and the Laboratory (Eng. Pierpaolo D'Agostino)

Fig. 7 Examples of plastic study models made by students of the Applied School of the University Federico II of Naples

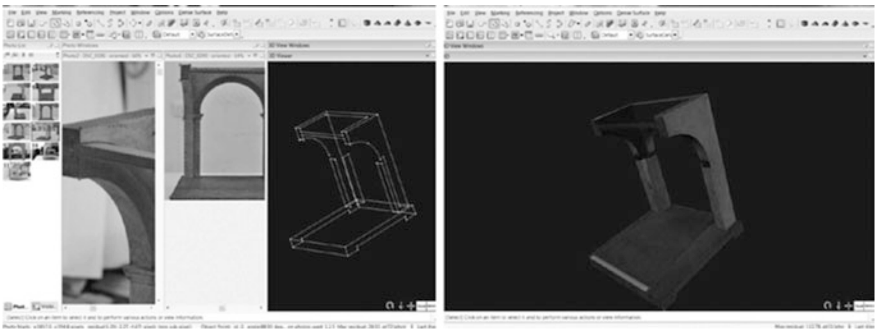

Fig. 8 Some passages regarding the modeling of the *maquette* presented in Fig. 7

perspectives; summits and profiles for a three-dimensional reconstruction of elements; textures for visual enrichment of the created volumes (Fig. 8).

The described phases are not, however, of trivial application because they require also a multidisciplinary knowledge, otherwise they risk becoming uncritical and notional application of steps. For sure, to a plethora of non-experts, such as students in their first years of university study, thanks to the first steps in three-dimensional modeling, a step-by-step familiarization with architecture is possible and so a gradual awareness of being able to read and interpret volumes and forms.

Hope remains that in training courses, taken both by students in Engineering and those in Architecture, an ever more didactic chain may be articulated justifiably, in order to allow them to master and integrate, in an informed way, expressive forms and different technologies.

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Paul Klee. Principles on the Nature of Colour. Theory and Practice

José de Coca Leicher

Abstract Between 1921 and 1923, while teaching at the Bauhaus in Weimar, Paul Klee taught three periods of lectures and exercises titled *Beiträge zur bildnerischen Formlehre* [Contributions to a pictorial theory]. We study the final part of the notebook (winter semester 1922–1923) dedicated to the theory and practice of color, preserved at the Paul Klee Center in Bern. Nucleus of his teaching which runs until 1931, beside with other aspects contained in his diaries and letters, the trip to Tunisia and the influence of artists and theorists such as Delaunay, Kandinsky or Goethe.

Keywords Paul Klee · Color · Theory

In the context of the prolific teachings at the Bauhaus, the colour theories of Johanes Itten, Wasilly Kandinsky, Paul Klee and Joseph Albers are known to a greater or lesser extent. All of these theories are based to a more or less extend on the purpose of establishing a general theory starting from the experiments by Isaac Newton, the essential contribution of Johan Wolfgang Goethe and of other scientists and previous and contemporary artists.

The teachings of Paul Klee about form and colour began in Weimar in 1921 and continued until 1931 in Dessau and they had an important influence on his students. In his search for connections between nature and art, a vision of the artist as a tree emerges, where the roots are nourishing by reality which at the same time is feeding the treetop. A symbol of a new artist, looking at time and at the multidimensional space, which once again is a mirror of the root.

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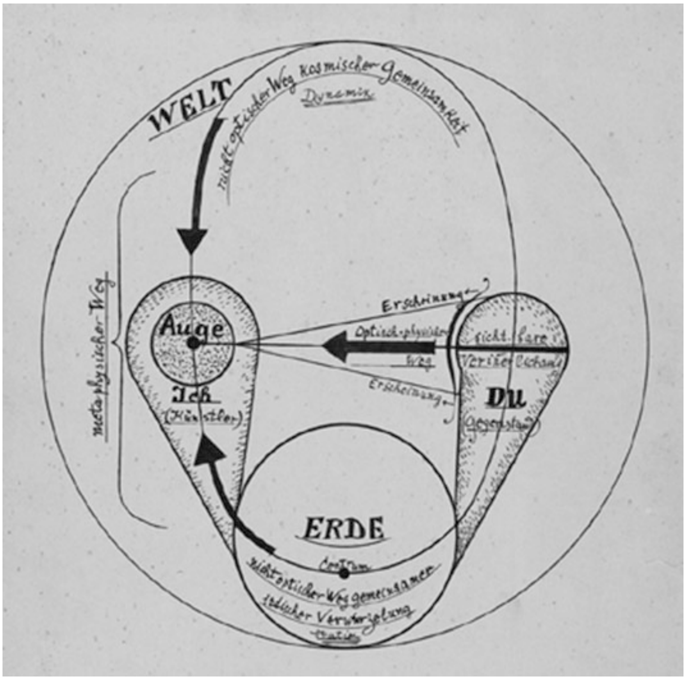

Fig. 1 Sketch: I-You-Earth. [Ways of Nature Study], 1923, BG A/30. Zentrum Paul Klee, Bern

The attractive example demonstrates the poetic essence of his thinking and the attempt to distinguish between nature and art as one of the fundamental problems of our time (Klee 1945, 13–16). In his lecture on modern art given in Jena in 1924 and published in 1945 under the title "Über moderne Kunst", he sets the three dimensions or orders of painting: the line associated to the measure, the tonality to the weight and the colours to the highest dimension, the quality. For Klee the three variables are intersecting in colour: first quality, second measure and third weight. Klee asks himself: What is the order of the nature of colour? (Klee 1945, 19) (Fig. 1).

The studied material is taken from the cycles of classes taught in the preliminary course between 1921 and 1923, titled *Beiträge zur bildnerischen Formlehre* (BF) [Contributions to a Theory of Pictorial Form],[1] in particular lesson 10, in the final part of the notebook, in which the principles of "Farbenlehre" are set [Colour Theory]. The study is expanded with material of the compendium made in 1928 and titled *Bildnerische Gestaltungslehre* (BG) [Theory of Creative Design] with some

[1]Handwritten notebook with 192 pages including the 3 cycles of lectures given between the 14th of November 1921 and the 19th of December 1922. The dates on which lectures are taught are indicated and there are annotations showing that the material was reused for cycles of lectures later compiled in *Prinzipiele Ordnung*.

Fig. 2 Red and white domes, 1914, 45, Tunisia. Paul Klee. Kunstsammlung Nordrhein-Westfalen

illustrations of the notebook 2 *Principiele Ordnung* (BG 1.2) [Main Order][2] and materials of *Anhang* (A) [Annex] containing the final schemes of the lessons and some works of students.

The working principles of the mechanisms of creation that Klee had reached are exposed in *Beitrage zur bildnerischen Formlehre*. These principles had been announced in the previously written *Schopferische Konfesion* (SK) [Creative Credo] (Klee 1920) that were a part of the texts compiled by Kasimir Edschmidt[3] of: "… a vision of the strongest artistic profiles that constitute our time, about themselves: the work, the time and the world." (Fig. 2).

Also in the pages of his famous Diaries (T) (Klee 1987), written between 1898 and 1918, the reflections and the improvements from the drawing towards the

[2]Contains the manuscripts of the lessons taught initially in the winter semester of 1923/24, with an index with the references to the pages of BF, reused from the previous semesters (see: http://www.kleegestaltungslehre.zpk.org/html/chapterInfo/BGI_2.pdf).

[3]Max Pechstein, Max Beckmann, Arnold Schoenberg and Franz Marc, would be among the best known in the sphere of Paul Klee.

artistic use of colour are described with fundamental episodes like his visit to Robert Delaunay in Paris (in 1912) and the later translation of his text: “La lumiere” for the magazine *Sturm* (Klee 1987, [910, 913]). The performance of the Russian Ballet with Vaslav Nijinsky in Munich in 1912: “He dances both in the air and on the ground” linking this remark with the emergence of the new ideas of the Futurists and their Manifesto: “when a window is opened, all the street noise suddenly penetrates in the room, also the movement and essence of things outside” (Klee 1987, [916]). The relationship with Wassily Kadinsky “the boldest of them whom also tries to work through the word” (The Spiritual in Art, published by Piper) (Klee 1987, [905]) and the painters of *Blaue Reiter* (The Blue Rider) Franz Marc and August Macke, with the essential trip to Tunisia, in April 1914 accompanying the latter and the painter Louis Moilliet, where he wrote:

> I now stop working. I feel deeply being a part of the environment, I feel it and it gives me confidence in myself without effort. Colour possesses me. I don’t have to pursue it. It will possess me always, I know it. That is the meaning of this happy hour: Colour and me, we are one. I am a painter. (Klee 1987, [926o]).

The watercolours series, performed before and after the trip, of vivid and steamy colours extending on a more or less perceptible grid from which emanate domed, organic or plant shapes, are the result of the assimilation of many influences in his evolved abstract thinking: the theory of *simultaneous contrasts*, the windows and cathedrals by Delaunay, the moving shapes and colours by Carlo Carra, Umberto Boccioni and Gino Severini, without forgetting Jacopo Tintoretto, Eugene Delacroix or Ferdinand Hodler, while he sets at the same time the aim of the artist as a creator, the autonomy of expression against the impression, as indicated in the Creative Credo:

> Art does not reproduce the visible; rather, it makes visible. A tendency toward the abstract is inherent in linear expression: graphic imagery being confined to outlines has a fairy-like quality and at the same time can achieve great precision. The purer the graphic work, that is, the more the formal elements underlying linear expression are emphasized, less adequate it is for a realistic representation of the visible things. (Klee 1920 [1981], 6).

Experiments with smoked glass accomplished around 1918, previous teaching at the Glass Painting Workshop of the Bauhaus, always accompanied by a deep knowledge of music, as a melomaniac and soloist of violin. On this basis, we will try to describe some key aspects of the colour theory preserved as lectures and exercises in the notebooks at the Paul Klee Zentrum.

The basis of the theory is specified in the nine previous lessons, which have been recompiled in 1924 and published in Munich in 1925 by Albert Langen as the Bauhausbücher number 2, entitled “Pädagogisches Skitzenbuch” [Pedagogical Sketchbook] with some of the graphic materials from the lessons—reduced to ink drawings and texts—sometimes hardly understandable due to their schematic and brief nature (Klee 1925, Klee 1953).

The first lesson of the notebook *Contributions to a Pictorial Theory*, given in November 1921, is dedicated to the line as a plastic medium. Considering a line as a moving point it can be shifted in a freely and “active” way. By creating closed shapes like a triangle or a circle it acquires a "medial" character and becomes completely "passive" when filled with colour. The suggestive drawing of a horizontal eight, forming a continuous loop crossed by 3 vertical fields: the active, medial and passive layer that synthesizes these ideas, will not appear until the lesson on May 1922 and will also be published on page 11 of *Pedagogical Sketchbook*. This sketched-symbol expresses the ideas that so much obsessed Klee—genesis, change and transformation—and it is an important step in the achievement of a spatial and multidimensional order of colour (Fig. 3) (Klee 1925, 11).

In the second lesson, from the 28th of November, the line jumps from the surface into space setting the foundations of perspective representation. In the lessons from the 5th and 12th of December, he tries to check how the colour equilibrium works using the example of the balance that after Christmas was developed by incorporating ancient capital letters. In the class from the 16th of January, he enters into the field of rhythm and geometric structuring of the picture surface (Fig. 4).

The repetition of a certain rhythm that cannot be divided, the "individual", is associated with the figure, for example a fish, and the "dividual" or abstract is subdivided into parts that grow as a grid or ornament in all spatial directions. These possibilities are exemplified in music, with the intonation of the beat of a melody. Mid-February, the notions of active and passive were applied in anatomy which are explained by means of the nerve impulses sent from the brain (active), translated into movements through muscles (active) and bones (passive). Parting from those principles he proposes an exercise based on the construction of a three-part mechanism, showing possible solutions with the examples of the waterwheel, the plant and the bloodstream. Klee says that movement is the origin of creation, reproduced from the genesis of the work, indicated by the symbol of the arrow or by an equilibrium, the gradation or the contrast of the colours in the composition,

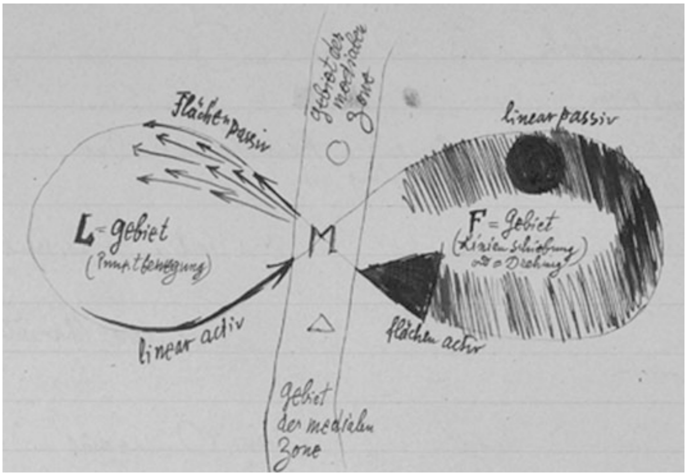

Fig. 3 Repetition of active, medial and passive. BF/149. Zentrum Paul Klee, Bern

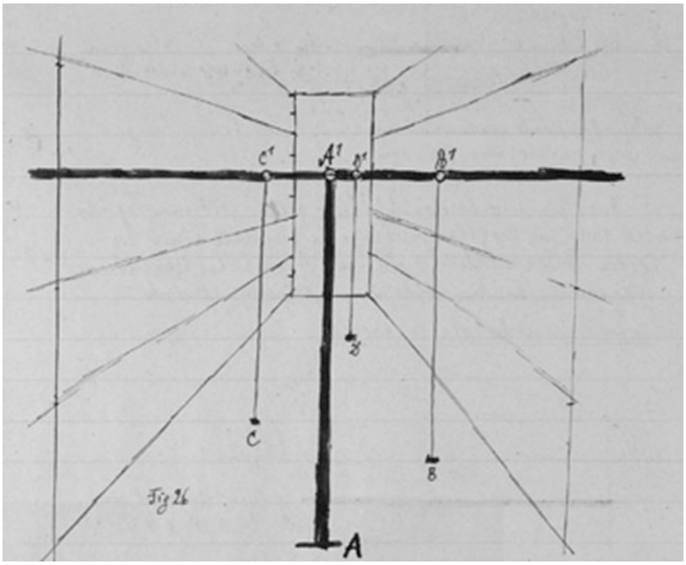

Fig. 4 Perspective. Elements balanced in space. BF/26. Zentrum Paul Klee, Bern

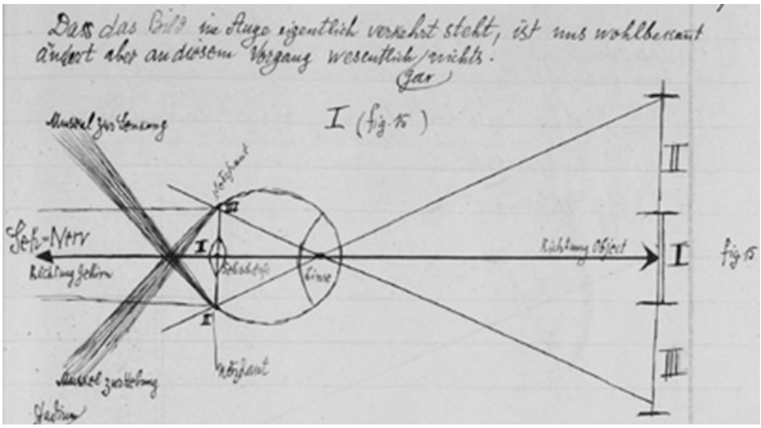

Fig. 5 The viewer's eye movement. BF/100. Zentrum Paul Klee, Bern

which are finally perceived through active movement of the eye around the surface of a painting (Fig. 5).

During the summer semester of 1922, Klee concentrates the previous contents into 6 classes (15 May, 22 May, 12 June, 19 June, 26 June and 3 July) providing a summary in the last class of the 3rd of July. In the following winter semester, the contents relate only to colour. There are two lessons, 29th and 19th of December, and two exercises (the 5th and the 12th of December), all in 1922. Based on the chromatic circle and triangle, he sets out the fundamental principles of the colour theory, inspired on some precedent theories which are mentioned at the beginning of the class on the 22nd of November:

> I want to try to tell you something useful about the colours. I rely not only on my own ideas, but in order to transmit these utilities I incorporate without objections the reflections of others. To clarifying I mention a few names: Goethe, Philip Otto Runge, whose *colour sphere* was published in 1810, Delacroix and Kandisnky (The Spiritual in Art). (Klee 1922, BF/156).

The aim is to set an ideal colour box in which a fully justified order is reached. For Klee, colour is obtained from nature, from plants and animal world, mineralogy, the landscape, highlighting the rainbow as a phenomenon that acts as the abstraction of all coloured things. 7 colours are derived from it: red-purple/red/orange/yellow/green/blue/blue-violet, which also fit well with the 7 notes of the musical scale. But Klee thinks that the linear nature is insufficient because red-violet and blue-violet are "incomplete", considering, on the one hand, the division of the colour wheel in the green/orange/purple colours facing the red/yellow/blue and, on the other, the pendulum movement that becomes circular by joining at the ends of the two incomplete colours. The way of reaching the famous colour wheel is new, also is new its dynamic and gravitational conceptualisation, distinguishing two types of movement: the diametrical and the peripheral. There are 3 diameters facing the pairs blue/orange; violet/yellow; red/green, indicating the classic complementary relationship and also the gradual transition (expressed as another pendular movement) from the pure colour end towards the centre or equilibrium position represented by the "neutral grey". These colours are called "authentic". There exist infinite colours diametrically facing each other as we move around the perimeter. Pairs of "not authentic" colours come together by secants (the characteristic colours by Goethe), resulting a mixture of "not neutral grey", for example, by mixing green and orange we obtain a green loaded with yellow (Fig. 6).

As for the peripheral movement, Klee wonders in the lesson from the 19th of December about the scope of the three primary colours: red/yellow/blue, noting that each of them occupies two thirds of the circle partially overlapping and leaving the other third free. This is shown with the red. In the centre of the arc is the "culmination of red" and towards the end there are two other points: the "warm end of red" that matches the "culmination of yellow" and the "cool end of red" that matches the "culmination of blue". In this way, Klee manages to express the tonal transition from one fundamental colour to the other two, from the "nothing" in the "highlight" of the adjacent colour until its maximum intensity and tonal strength at the ends of the other two. The musical analogy leads him to express the concepts of "chain" and "canon of totality":

> Then, there is something else: the colours on the circle do not sound at the same time as it might seem according to this chain, but in a sort of trio of voices. This representation allows us to recognize the movement well and follow easily its evolution. The voices consecutively enter in the form of canon. In each of the high points culminates a voice another enters softly and the third disappears. (Klee 1922, BF/179).

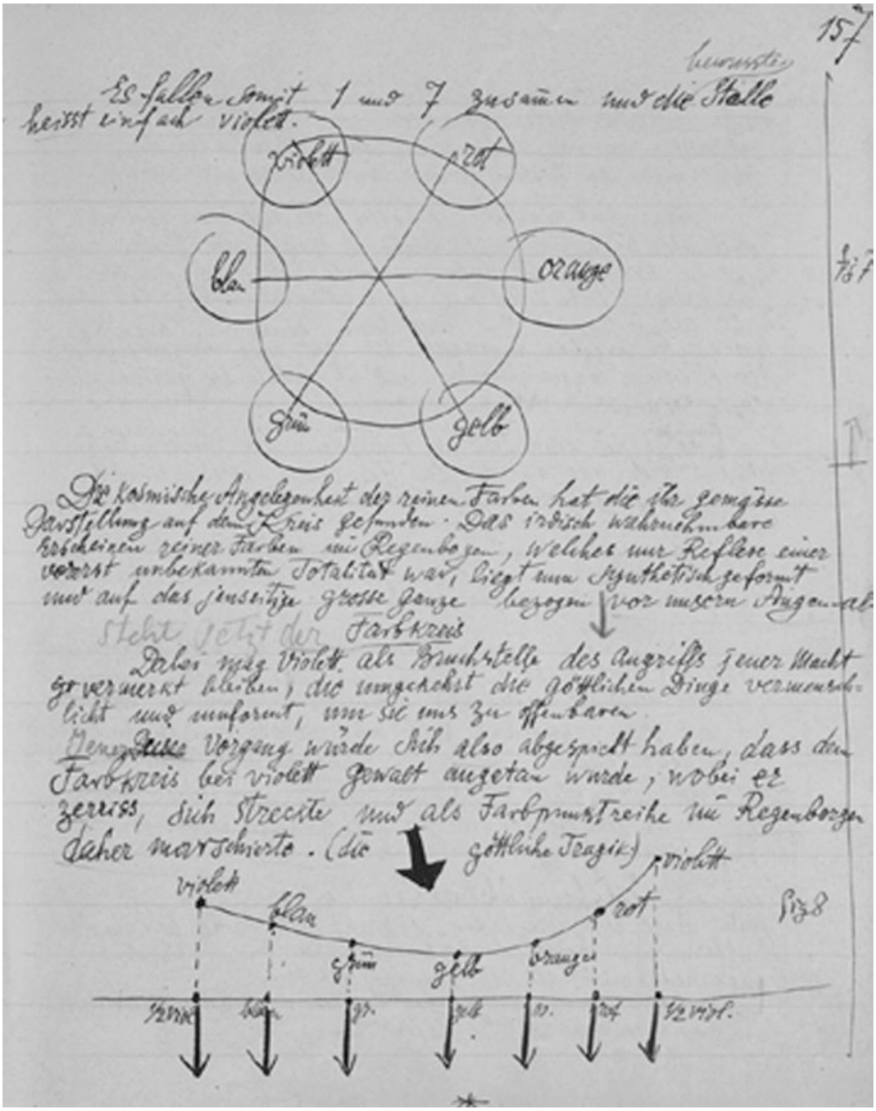

Fig. 6 Chromatic wheel and violet-purple pendular movement. BF/160. Zentrum Paul Klee, Bern

At the end of the notebook, Klee explores the representation by the colour triangle obtained from the circle. It is an equilateral triangle in whose apexes pure colours are represented: red/yellow/blue with its quality of maximum purity in the "culminating point". The sides are occupied by secondary or dependent colours: green/orange/purple. The possibilities of relationship obtained from different movements in the triangle, as analysed in the following pages, do not satisfy Klee.

Despite obtaining the grey, either as the centre of gravity of the triangle or the circle centre, the relationships of the light and dark are not explained by the incorporation of black and white. On the last page of the notebook, a three-dimensional model is obtained from the colour triangle and the two apexes in the vertical of the grey, the upper corresponding to the white colour and the lower to black, forming the "totalis pentaeder", a first step towards the spatial topography of colour (Fig. 7).

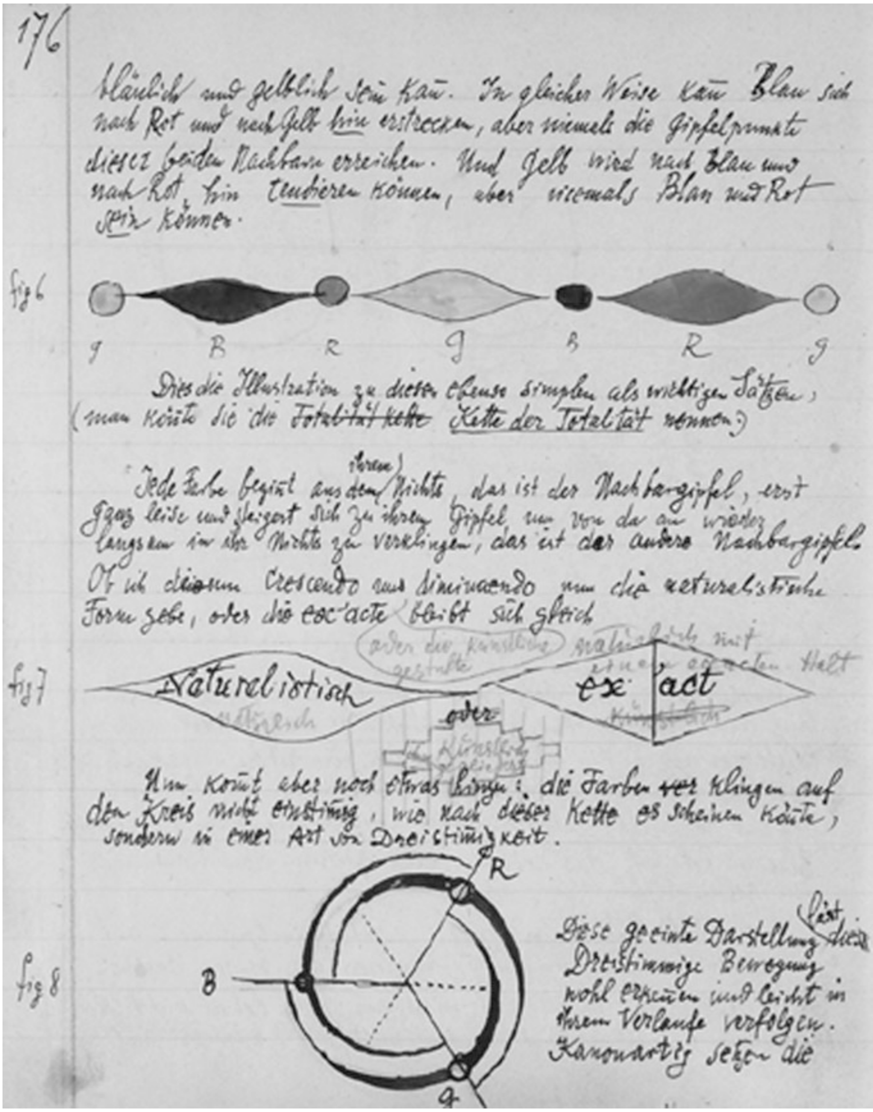

Fig. 7 Canon of totality of the main colours. BF/179. Zentrum Paul Klee, Bern

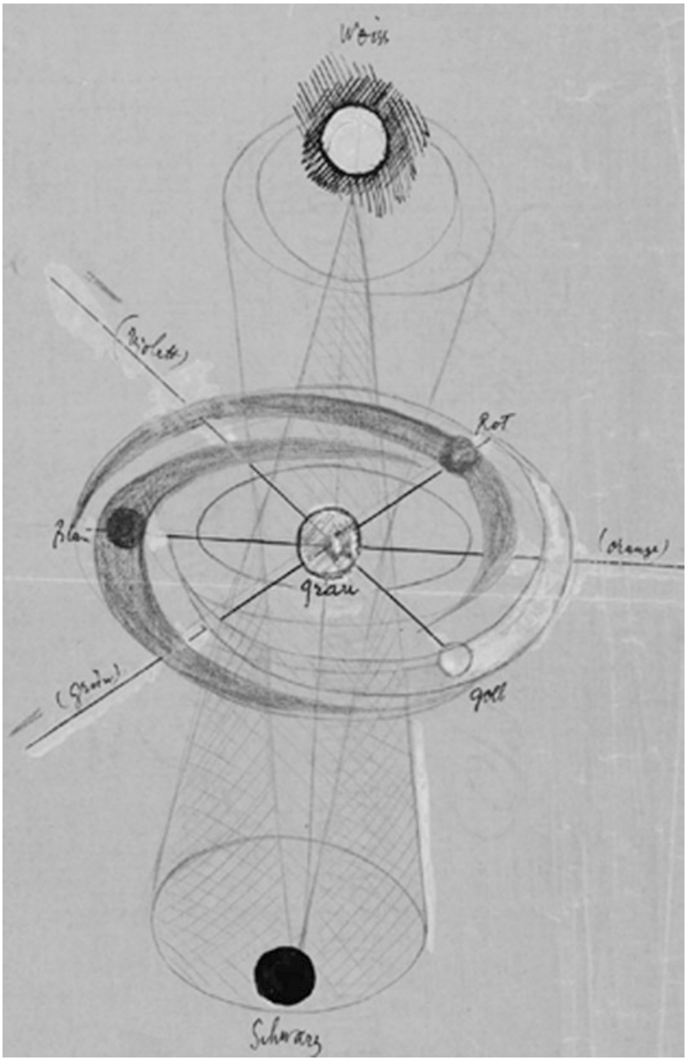

Fig. 8 Canon of totality in three dimensions. Cosmology colours. BG 1.2/156 Zentrum Paul Klee, Bern

> With these few examples I have concluded the elementary topography of colour. The next time I will return again on it in order to extend the topography into space. In between, maybe we rehearse again (Klee 1922, BF/193).

At the beginning of 1924, Klee treats the plastic means in detail. Even though the line is commented briefly, the explanations are focusing on chiaroscuro and colour, using the previous notes as a basis for the principles of the theory, as he had explained in the winter semester 1922. In the lesson on the 12th of February he will say:

> To get the colour totality with the main points: white, red, yellow and black, we are forced to depend on a spatial order, we find ourselves obliged to stretch fully our colour box to the three dimensions and, obviously, get a sphere (Klee 1928, BG 1.2/125).

The colour dimensions are treated by means of the sphere of Philip Otto Runge. The direction from top to bottom corresponds to the illumination, of left to right to the temperature. He will also establish the variations of each tone with the mixture with black and white, and which geometric shape is equivalent to each colour. Klee dedicated much attention to the behaviour of the pairs of colours, whose ultimate objective was its usage for getting balance and compensation in space (Fig. 8).

The organized and systematic use of colour comes from the palette which is organized according to the three diameters of pairs: blue/orange (horizontal), green/red (diagonal left) and yellow/violet (diagonal right). Each colour tonality will move in concentric circles from the outside to the centre: white polar circle, spectral circle, black polar circle, grey circle. In the centre of the palette, in three of the six sectors there are located white (left), black (centre) and grey (left), forming the pole which is ultimately a projection of the vertical diameter of the sphere. Everything is described in a splendid scheme that appears at the end of the *Prinzipiele Ordnung* notebook (Klee 1928, BG 1.2/161) and manages to express the spatial order as a cosmology of colours that orbit the grey circle (Fig. 9).

As conclusion, Klee keeps some student exercises in the annex. In the descriptions of the lessons, which also work as a diary, he always proposes some exercises, usually to be done within one week, and with annotations of comments on the results, often considered as unsatisfactory. This sometimes leads him to redirect or expand the lessons starting from the difficulties of students, despite being his theory a very reserved and difficult to apply for someone different than himself. Pedagogical

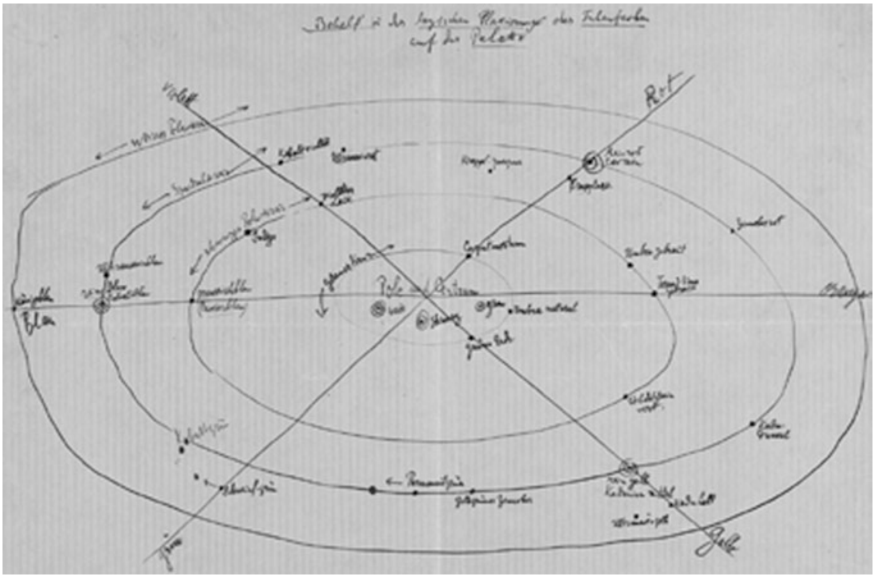

Fig. 9 Logical placement of colours in the palette. BG 1.2/161 Zentrum Paul Klee, Bern

risks are evident, the linking of students to the idea of harmony and totality based on the proposed instruments, which perhaps are too immediate translations of the teacher's experiences, may lead to an inability to explore own paths and ideas. This can be seen in the exercises and later works of students that did not escape from the teacher's influence; Klee never showed a rigid attitude and favoured personal exploration, trying to prevent his pupils from the strict use of the formulated laws (Wick 1988, 230). At the conclusion of the lesson given the 19th of December 1922 about colour topography, he will say:

> These ideas themselves lead to the construction. They hit the heads of asthmatic people with narrow chest, who produce laws rather than works. Those have a little mind to understand that laws are only a basis to flourish on them. Laws are only used to see how works are different from the surrounding nature, the earth, the animals and the people, without necessarily being absurd. Laws are only a common basis for nature and art. (Klee 1922, BF/188)

As he insisted, his pedagogy avoid any dogma. He wanted to provide his students the aspects and basic tools of colour and shape such that they could freely advance

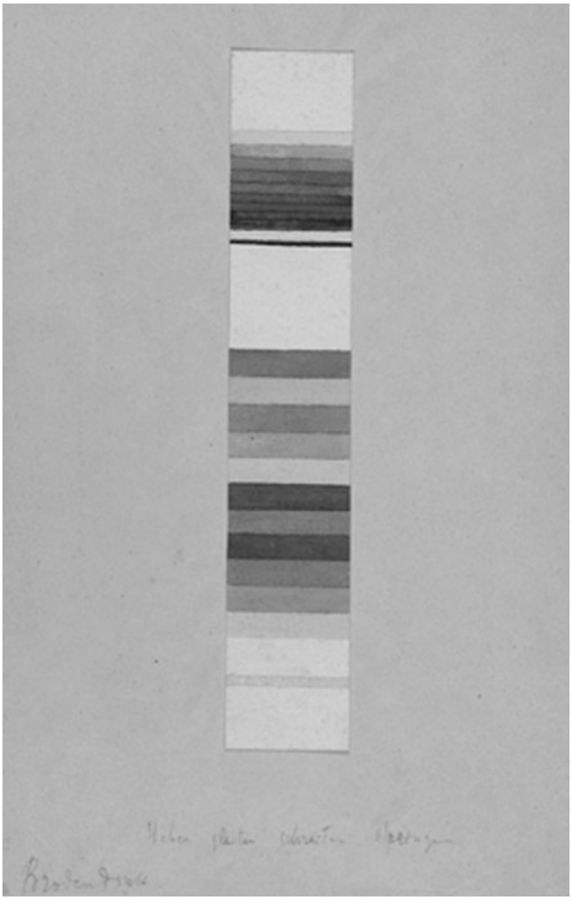

Fig. 10 Standing, slide, walking, jumping. Exercise: types of movement, chiaroscuro. Student: Brodendink, BG A/497. Zentrum Paul Klee, Bern

by themselves. This is an absolutely valid objective in any pedagogy that should enhance the autonomy and personal development, especially in the use of colour as a vehicle of personal expression and creation, also in the field of architecture (Fig. 10).

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New Times, New Needs. Tradition and Technology in Drawing Teachings

Flavio Celis D'Amico and Ernesto Echeverria Valiente

Abstract The research analyze some of interactions between the digital and the analogue worlds that are current affairs in graphic teachings, by exploring the seek points and the particularities of each modus operandi. A situation that is not only present in our student's assignments, but also in our own education and daily work. In particular, it analyses those methods saddled between the digital technologies and the manual means, as photography, mapping, sketching and modeling, and how they all merge together, forming integrated visual communication systems.

Keywords Drawing · Photography · Mapping · Sketching · Modeling

There was a time, not very long ago, when the debate about graphic design teachings was bogged down in the dichotomy 'computer versus hand-drawing'. Fortunately, those times were overcome with an inclusive speech where the success of the methodology was based on the appropriate combination of both digital and analogue. Nevertheless, a few years after, the issue hasn't been completely solved, and the subjects, practices or moments for each kind of drawing still being an on-going topic of discussion. We understand that both worlds must coexist in the academic as they do in the professional field. However, the question about the most proper area for developing each of them stands nowadays clearly far from being considered solved; even further, if considering that learning and working are not required to follow the same guidelines nor methods for achieving their goals (Marina 1993).

First of all we must highlight that, unlike mostly of their university professors, our students are digital natives, so they never did need an adaptation period to get from the analogue to the digital world. Thus, we should consider that the learning of manual skills, as hand-drawing is, could be as foreign for them as it once was the

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learning of a computer drawing program protocol. However, this fact does not appear to be decisive, considering the low, not to say extremely poor, graphic background of the students starting the architecture career. Learning to draw with a computer program might be more affordable for them than following less formal, more hermeneutic, learning methods, because of their intuitive ability in using computer systems which implement standardized algorithms.

Furthermore, the continuous and rapid evolution of the digital world turns volatile any consideration taken in a specific timeframe. Take, for instance, the sketches of urban or architectural sites made in situ, a very common practice in any of our drawing courses. Well, we all agree that it is an optimum task to be done by means of the hand skills in a sketchbook, trying to capture the most significant attributes of that very object, building, set or landscape we observe, to finally express on paper only those we found meaningful, essential or more representative. But, if this same work is done with an electronic tablet, using a sketching digital program, so the resultant sketch could be reworked with a picture processing program, we would be facing a combination of digital and analogue means with very vague limits in between. Positively, what the future holds is an increasingly closer collaboration between these two worlds, and the gradual loss of their borderlines, achieving a world of blurred limits. A highly likely situation, since technology tends to provide increasingly comfortable environments for the user, defining this as the ability of interacting with the digital mean in a more "natural" way, without having to study complex protocols of specific instructions (programs).

This article tries to analyze some of this interactions between the digital and the analogue worlds that are current affairs in our graphic teachings, by exploring the seek points and the particularities of each modus operandi. A situation that is not only present in our student's assignments, but also in our own educational daily work. In particular, it analyses those methods saddled between the digital technologies and the manual means, as photography, mapping, sketching and modeling, and how they all merge together, forming integrated visual communication systems.

1 Image Photography and Video

Two have been the basic conventional methods for visual representation in architecture: drawing and photography. In fact, many times drawing has been incorrectly regarded as a reductionist uptake of photography. A very common simplification among students, and one of the basic issues to be solved at their start learning graphics. However, the using of photography shouldn't be rejected as a bad praxis in graphic teachings (those neglected drawings made by staring a picture). Quite the opposite, photography, featured in the appropriate context, must be taught as an essential supplement of the graphic work. Photography can be taken as a graphic tool in many levels. For instance, it could be considered as an auxiliary documentary system, and be regarded within the conventional representative modalities, with its particularities, but it could also have some proactive intentionality when used as a system to abstract reality by modifying the viewpoint, the frame or the focus in a no conventional way (Carazo and Galván 2008). It's quite clear that significant differences appear when comparing a photo with a representative sketch. This is because the graphic mean, as a human construct, is always purposive, while photography, although it also offers a high level of freedom (by adapting the frame, focus, speed control and diaphragm), has always been under some degree of unmanageable automatism.

The photography could also be used as a link between the real context and the projected architecture, at the concept stage and communication. In that situation, it implementation generally consists of photomontages, either by creating compositions with a number of different photographs, or by inserting the drawing of the project in the photography of the context. The History of architectonic representations (from Mies van Der Rohe's photo-collages of his project for a glass skyscraper in Postdammer Platz, passing through the ones made by Allison and Peter Smithson in the fifties, to the current influenced by advertising) is full of interesting examples of drawing and photography combinations showing a wide range of attractive graphic propositions.

Digital media, as scanners and digital cameras, along with image-processing programs, have facilitated the photomontage work, but have also opened up new suggestive possibilities, like the processing and combination of hand-sketched drawings and photographs of the real environment. A work done in such a way, that it is nowadays possible to produce completely new images from traditional methods. This raises the following questions about the cataloguing of many of the latest images appeared in competitions, design contests and projects portrayals: are those pictures, photos, photocompositions, digital images, collages, etc.

In the pedagogic field, photography has a very interesting scope of application as a visual support for the teaching of certain concepts and drawing methods. For instance, it has been proven how the understanding of the elements of the lineal perspective can be exemplified via the analysis of certain photographic frames, subsequently drawn by the students. These practices look forward to establish a constructive relationship among photography and drawing. It is easier, for beginners, to draw from a photo, sorting out the fitting, the perspective and the framing problems of every drawing. In addition, the students learn to discern the representational and conceptual differences between a photo and a sketch.

With regard to the video, be it via moving pictures, or via animation of static images, creating animated clips, it is nowadays a rising trend in the submission of projects. Not to mention the possibilities of the augmented reality, and its multiple combinations between image and design. A very new, and still too expensive technology that requires the prior knowledge of several design techniques, as the virtual 3D modeling, which hinders its implementation in the primary levels. But still, as well as with the other new technologies, it would progressively be incorporated to the work procedures.

2 Planimetric Drawing and Precision Drawing

One of the essential chapters in the drawing teaching is the planimetric drawing. Measuring and scaling architectural objects involves a work for conceptualizing reality and its assimilation to the specific architectural codes. Traditionally, the measurement of buildings has been made by manual techniques: lineal measurements with a tape measure, triangulations and height measurements, either by using constructive references (measuring layers of brick, for example), or by using original analogical inventions (balloons), or by using more complex systems, as trigonometric triangulations. The emergence of laser distance meters and the most sophisticated EDM's (capable of calculating the height by triangulation) has meant a significant reduction in working times, although they still being manual tools. The appearance in recent years of digital photogrammetry software, in particular the rectification by orthophotos, involves reducing the volume of the measurements taken by hand (it is now enough with a measure of length and width on a picture to rectify an entire façade), to a point where there is no need for the traditional planimetric work out (Alonso and Calvo 2010). The traditional measuring system becomes obsolete facing the latest measuring devices generation. With these 3D scanners, in a single pass, a geo-referenced point cloud can be obtained and subsequently worked in a three-dimensional CAD software, resulting in bi-dimensional manageable files, as sections, plans and elevations, with fine resolution (San José Alonso et al. 2008).

It can be argued that the use of these systems is still limited to a professional and specific activity or to post-graduate researches but, since technologies are cheaper every day, it is not unreasonable to imagine a future widespread of these 3D data collection systems. In the academic field is increasingly important and relevant learning to use these instruments, because it makes no sense trying to apply the traditional methods when studying complex architecture examples. Even though the manual measurement techniques would remain a useful way for teaching the importance of rigor when measuring architecture, this type of exercises can be applied on smaller scale or less intricate examples.

3 Sketch Drawing

There are two drawing modalities where the use of digital systems has been long in coming. Precisely those that have to do with the creative process, with a lesser degree of codification and a bigger need of freedom for interpret: the sketches, in general: analytical resources for interpret and represent reality, where the only codification (and it can also be avoided) is the use of perspective (more conceptual than lineal); and especially, the sketches at the beginning of the creative process, which prefigures the first ideas of a project. Through the use of quick strokes and marks, complex ideas can be expressed and modified, establishing a direct relationship between reflection and action. By the movement of the hand, these traces, sometimes surprising and unexpected, articulate a discourse of non-preconceived ideas, in contrast with the CAD programs procedure. In this regard, seems like the manual means, due to their unpredictability and inaccuracy, were more capable of performing that generating function than the rigid computer-aided design programs. Although there are examples in architecture design where both worlds (digital and analogue) are combined and complement each other (Fernández Ruiz 2008; Izquierdo Esteban 2008).

Nevertheless, in recent times we have witnessed a proliferation of touchscreens and other devices that allow translating hand gestures to the virtual world, store the information produced and be able to modify it later by using computer assisted drafting programs, as the Sketchbook pro, a digital painting, drawing and sketching software application, or the well-known Photoshop. In fact, there are already a number of professionals in the field of contemporary industrial design and fashion that have replaced their sketchbooks with touchscreens, preserving their creative freedom. Up to now, the main obstacle with these touch-sensitive digital devices was the price and their capacity, but both issues are currently been worked out, and there are, indeed, capacitive touchscreens of a good enough quality and at reasonable price.

Although using touchscreens have not yet managed to provide the quality and adequacy of the free hand drawing, with its variety of instruments and materials (graphite, charcoal, ink, marker, watercolors, pen, etc.) and the different textures of the many sorts of available grounds, it is nonetheless true that several sketching programs and apps have a range of tools that closely matches the real ones (most specially the linear and the color palettes), and also that we can print on many different papers. But it still feels distant and impersonal drawing on a glass surface.

Another constraint of the digital devices is the size and portability. Given that the price is proportional to the size, the most common tablet size is A5/A4, which restricts the expressive capacity of the gestures if compared to a 100 × 70 mm sheet of paper. This consideration is not insignificant because a relevant part of the drawing experience consists in adapting the object to the paper format. In fact, the work on large format papers has been used extensively in the traditional drawing teaching for its training capacities, because it is easier to correct errors when increasing the scale of the drawing, in addition to providing the students a feeling of control over the paper and the drawing process. Tablets solve this issue by increasing or decreasing the size of the image and the size of the canvas, but this resort does not affect the characteristics of the trace of the drawing.

In favor of using tablets is their capacity to interact with other formats and representational systems, as photography, and be able to combine them in the same medium. The content of the photograph can be drawn or written, and freehand drawings can be combined with CAD drawings. For teachers, the use of tablets replaces the traditional blackboard, a very limited working surface, allowing the professor to project on a large screen the full drawing process.

4 Models

In general, models respond to representative simulation modalities. They are miniaturized representations of previously defined objects, subjected to the rules and methods of the materials used to imitate the actual constructive ones. However, they can also be used as tentative quests of dimensional configurations, within the framework of conceptual modalities. In this case, the models must pursue some creative, stimulating finality through, for example, folding pieces of paper randomly, or in a structured manner. They can also be incorporated to symbolic formulations or to sophisticated presentations by means of complex photomontages, merging with pictures and drawings. When the model is very precise the supportive graphic material should also be. And, in case of conceptual or working models, the graphic support can be less accurate or even don't exist.

Traditionally, models have been made manually by addition. This means the model was drawn from a previous sketch, scaled and subdivided in cutting patterns, depending on the material processed. But, in recent years, physical models have been losing ground with respect to the virtual ones (Carazo Lefort 2011). Nevertheless, the emergence of numerical control cutting machines and the 3D printers have revived the physical model. On the one hand, the accuracy of these new systems overcomes the indeterminacy of the manual process, and the product can be made with absolute reliability. On the other hand, the relative constraints of these tools (regarding for example to the size and the working method) makes it all the more important the concept of procedure, in the sense of planning. Once again, the digitalization of the production process impinge on the need to avoid or minimize the vagueness and indeterminations, increasing the accuracy of the resulting model but, also nullifying all kinds of chance and surprise, essential incentives for creativity.

5 Image and Communication

The graphic subjects in the architecture career are turning, involuntarily or unplanned sometimes and more or less explicitly, into graphic communications subjects (Raposo 2014). In addition to the explicit knowledge that each of them develop on its own discipline, all of them have a common metalanguage about communicating architecture. An increasingly evident situation: from the exercises to the communication between teachers and students, between teachers or between the students.

The need to share graphic information (be in the form of examples and references or just to report results) has much to do with the current communication methods. Any exercise done during the course is always related to others as a part of the collective teaching experience. For this reason, the class is no longer a closed room, to become, via ICT's (Fernández y San José 2010), an open space to verify and validate the information. The publication of works, practices, support material or references on virtual platforms, such as those published as 'open access', with special emphasis in graphics, like Pinterest, become a commonplace, helping both, the teacher and the student. All this, that seem right at first sight, has some hot-spots, mostly related to the communicative method itself: the simplification of the communication suggests that a large part of the available contents is not satisfactorily contextualized, precisely because the immediacy and simplicity of the medium, leading to an uncritically learning.

6 Conclusions

In any case, and by way of conclusion, it is clear that we are immersed in a process with no absolute certainties and where the teaching practice is determined by the means chosen. It is not so much a question of the contents of the graphic design teachings, even less since the implementation of the Bologna Plan, but rather how to implement those (Fullaondo et al. 2010). The challenge currently lies on how to incorporate the new medium of expression and of graphic communication of architecture in a critical and productive way, trying to combine in a sensible way and without prejudice, vetoes and judgements all the facilities at our disposal (Redondo 2008). It requires considering the virtues of the traditional methods, in particular regarding to their proven self-reflexive and interpretive capacity, essential for reflection and to stimulate new ideas; and the new technologies, for their rapidity and accuracy and their proven communication and integration capacity.

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Part III
Design and Architecture

The Evolution of Cartography and Georeference

Francisco Maza Vázquez

Abstract Cartography—defined as the science that studies the set of scientific, artistic and technical operations involved in map preparation and analysis—aims to collect and analyse spatial data used to determine the geographic features that define a particular area. Ever since its appearance as a technical discipline, cartography has undergone a significant evolution to be analysed in the light of technological advances and spatial analysis techniques in general. Likewise, and within the processes of cartographic evolution, the importance of georeference to define the location of a space object in a coordinate system and certain geodetic datum should be highlighted. The following statement analyses the technological advances allowing geographic representation—as well as information management contained in databases and their connection to the spatial location of the phenomena—using a Geographic Information System (GIS), whose final result means to provide with answers to new global mapping challenges.

Keywords Cartography · Georeferencing · GIS

1 Introduction

The importance and interest cartography has always borne in various sectors of society and the dynamic evolution of techniques used through the different map production phases are, unquestionably, the two main subjects touching on the evolution of cartography.

This evolution of cartography has been down a path which must be analysed in lights of technological advances, including the contributions made today by electronics, computing and spatial analysis techniques in general. Alternative tools used in the past by humans have been advantageously replaced by more modern devices (hardware) and programs (software) used nowadays.

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However, we shall take into consideration what was wisely stated by the Cuban cartographer Manuel García de Castro—teacher assigned to Geodesy and Cartography in the Faculty of Geography in the University of La Habana—in his study performed in 1994 about cartography development in Cuba. The professor enounced: "*Many specialists, dazzled by the (certain) possibilities of computing, think that it solves any cartographic problem and they show an utter contempt for the theoretical foundations of cartography. Results are miserable*".

We subscribe wholeheartedly to the appraisal of García de Castro. Accordingly, any work and/or project in which cutting edge technology is involved should provide that theoretical-technical-cartographic approaches are not neglected when producing plans. Nowadays, most of the projects are made by the latest modern cartography procedures; however, it would be worthy to analyse if they are, in fact, the most accurate ones.

This modern automated cartography from twenty-first century—so-called the "Information Age"—is not only made by computing means but also intended to answer social and environmental concerns of a greater scope. It turns to be, in the end, the functional reflection of the Information Age society, where modern cartography develops into a very effective graphical modelling interface in DDS (Decision Support System) within the MIS (Management Information System).

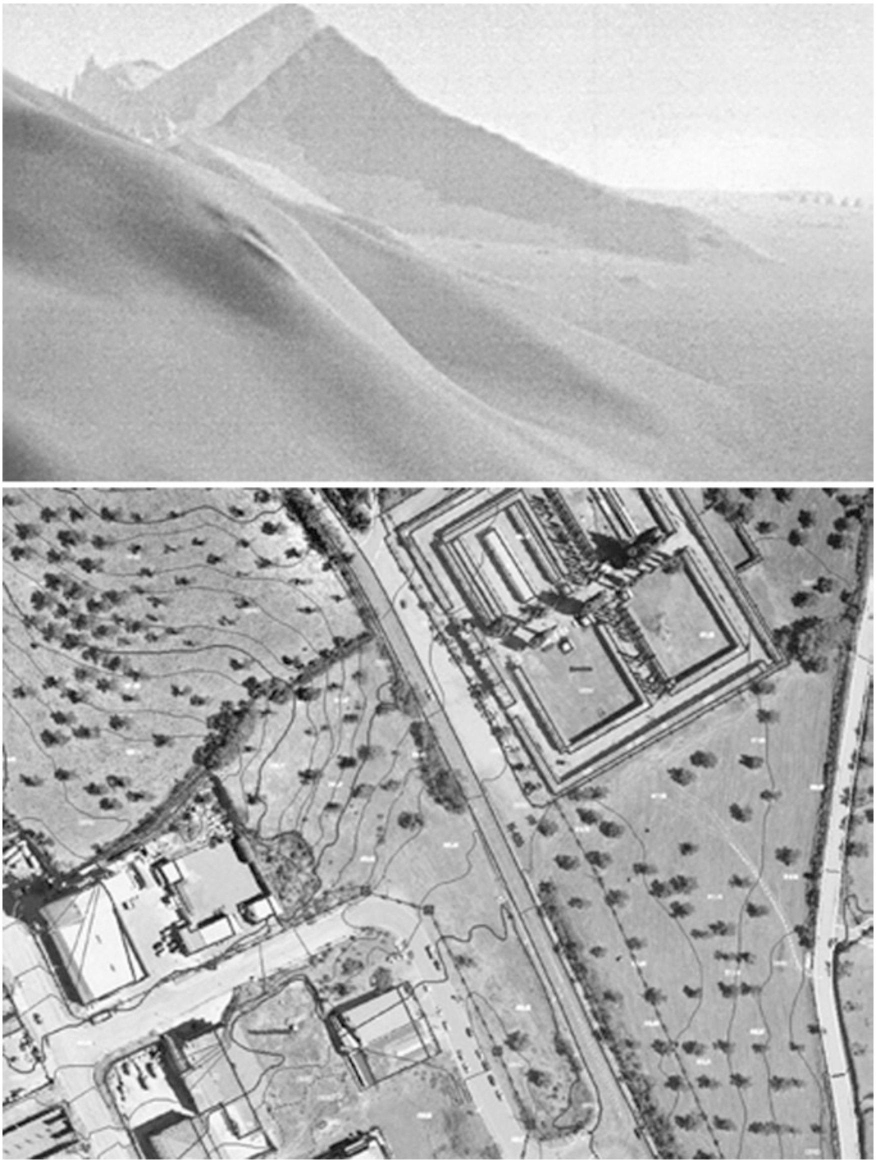
Likewise, new techniques in map production are facilitating investigation on the possibilities offered by this young cartographic aspect, testing the Geographic Information Systems (GIS) features within MIS and DSS, in the context of database information management an in their connection with phenomena's spatial location (Maza 2008).

Besides, these new techniques allow the evaluation of digital cartography suitability via orthoimages and digital terrain models (Figs. 1 and 2).

2 Technological Advances of Cartography

The technological advances of cartography experienced throughout history have occurred in different stages or methodological phases. Namely:

– Views: Those are the first graphic documents which led us to city knowledge. The study of the evolution of image and graphic expression, as well as the drawing of any city or terrain, offer us spatial dimension of historical processes and set the official coordinates to which subsequent proceedings will refer. That terrain or city image and their evolution are analysed primarily from the perspectives offered by the "views", true pieces of arts that patron kings commissioned to artists such Antón Van der Wingaerde and Pier Maríe Baldí, in sixteenth and seventeenth centuries respectively. The numerous representations these authors made through all Spanish geography and the valuation of urban structure contained in them, constitute a fundamental source of information

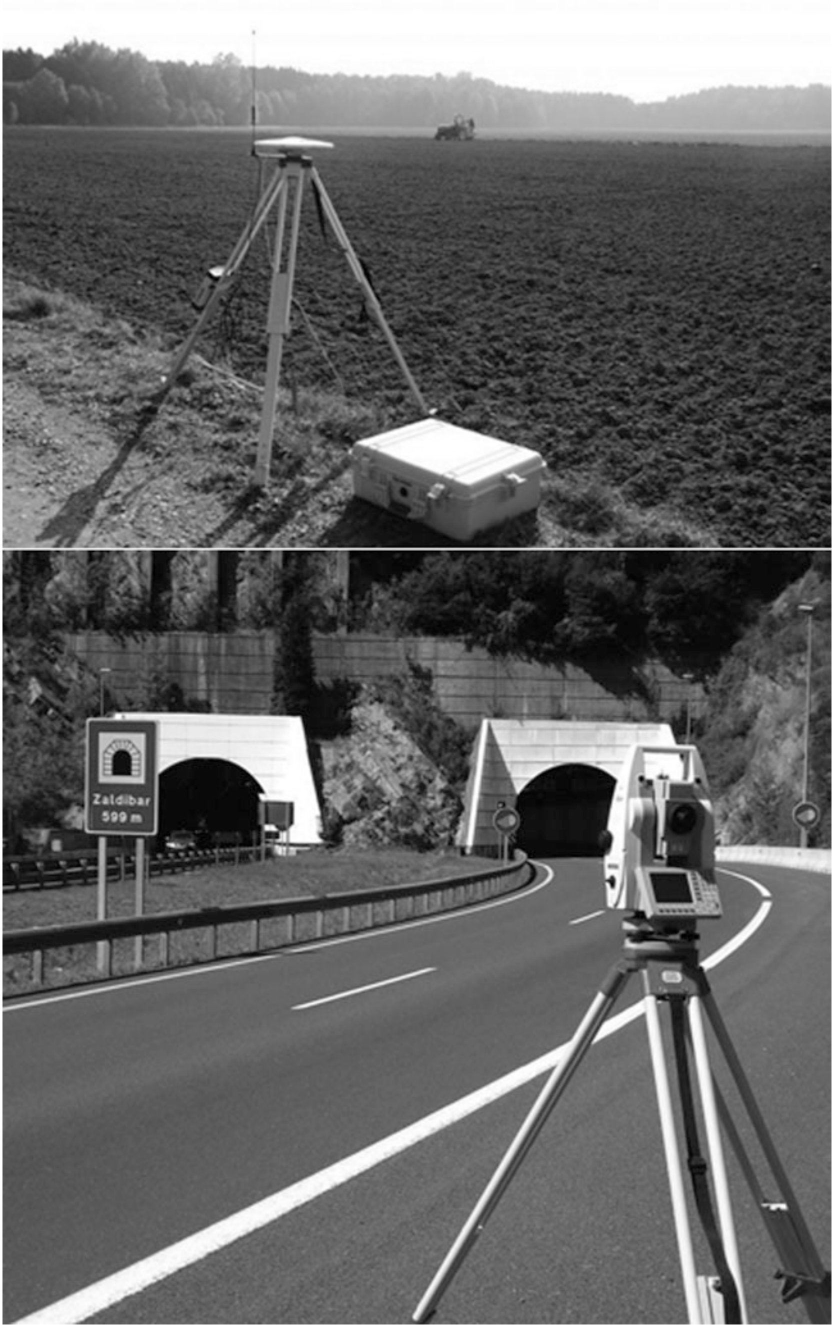


Figs. 1 and 2 Digital terrain model and orthoimage, including hypsometry by means of contour lines. Self-produced

to any official investigation or urban fabric existent in a determinate period. Even though they do not possess a metric character, they provide us with spatial answers about occupational population and architecture.

In this respect, the represented geographic space, based on the aforementioned connection man-environment, may be identified as a social product, as both its external and internal structure along with its changes, and its symbolist and contrasts, materialize technological and productive capacity, cultural and ideological dominant values and events, and even economic and legislative systems among other aspects. It means that these spaces represent the characteristics and internal logic of a certain society in a certain period of its historical development (Méndez 1987).

- Cartography obtained, long time after, by classic topographic procedures substitute the pictorial images or views, already using appropriate technical procedures and topographic devices which make metric quality of representations easier and enriched. In the first surveys carried out by classic topographic procedures, mathematics, trigonometry and descriptive geometry are used as sciences to acquire cartographic accuracy. The first devices to be used as topographic ones were tachymeters and theodolites, resulting afterwards in Total Stations, which are topographic instruments which include in a single equipment electronic, longitudinal and angular measurements, as well as internal communications which allow data transfer to an internal or external processor and are able to accomplish multiple measurement tasks, saving data and making calculations in real time. Besides, they have optical and mechanical elements, essential in every tachymeter.
- Photogrammetry, based on perspective and photography: Its usage started as a tool for the correct understanding of every data provided by aerial photography, with which it was be possible to obtain a first shot that shall be the base for creating urban development guidelines through the planning. Aerial images and photogrammetric surveys were made, at first place, by analogical restitution and physical devices by the late seventies. Subsequently, at the end of last century, those physical devices were replaced by digital photography (Figs. 3 and 4).
  The photogrammetric technique supports the obtaining of coordinates from reference points in an object in the space through restitution, from a minimal of two perspective and correlative images of the said object (Cundari 1983). The position of the objet point in the space is obtained from the intersection of two rays whose image centres of projection get together with the equivalent points of every image, provided they are placed in the position from which they were taken respect to the object we intend to restore. A photogrammetric model is constituted by a couple of correlative photographs knowing their position and relative orientation in the space.
- Remote sensing: Using this technology, we can study and manipulate satellite images to have special data from a certain terrain. Satellite images constitute nowadays a key tool, very reliable for space analysis of dynamics and urban areas. The using of satellite images present, as added value, the advantage of updating, as changes in urban spaces could be analysed practically every 20–30 days, depending on the temporal "resolution" frequency of the satellite.



Figs. 3 and 4 GPS equipment and Total Station used to create surveys by classic topography. Self-produced

Even, depending on image characteristics and their spatial resolution, much more detailed analysis could be performed, not only centred in urban space but in specific changes of residential, commercial or industrial districts. In this way, we can generate a terrain use map; obtain digital terrain models; detect the condition of great natural value areas, farming lands, cities studies and their communications; and so on.

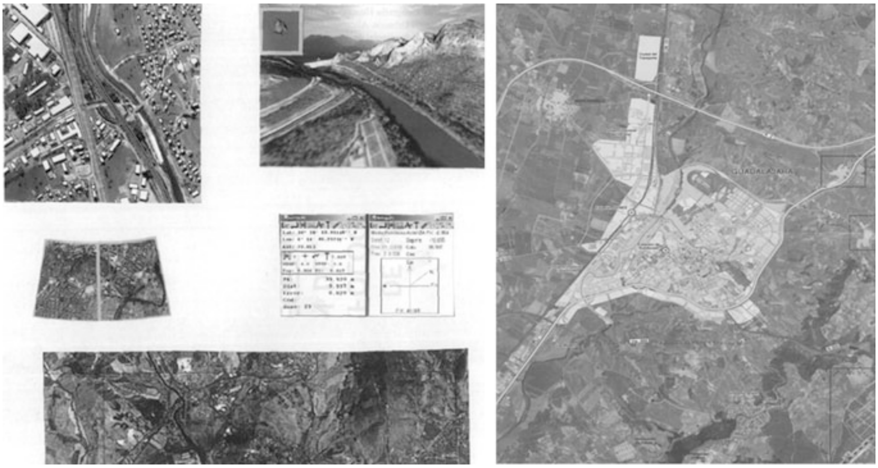
- Global Positioning System (GPS): These systems allow quick and precise localization of any place or phenomena on the earth's surface. Among other applications, we may quote georeferencing of objects in a certain terrain, depending on the geometrical properties of the geodata, afterwards enumerated. With this technique, it is obvious that a cartographic evolution takes place where a reference system and the origin of topographic coordinates and heights are chosen.
- Geographic Information System (GIS). GIS became more widespread in the eighties, its gestation and development date back decades. Between 1960 and 1964, the Canadian Geographic Information System (CGIS) was developed with the aim of managing forests and peripheral surfaces of Canada under a raster-vector structure which combined cartography with the necessary data for forest management. Timber forest volume and loading tracks studies were carried out as well as exploitation reports for forest management in the country. This system has gradually evolved and continues in use nowadays.

The current evolution of computing, both at processor and program level, has favoured the implantation of databases with territorial information at our disposal, having on one hand geographic data and on the other, alphanumeric. The conjunction of both in a computing system has been named relational database in a territorial system or Geographic Information System. The basic philosophy of a Territorial Information System lies in the unity and immovability of terrain.

These methodological concepts in the evolution of cartographic science are used as a base to provide to any planning instrument with the necessary cartography, to be used in its management and development phases. In this respect, from a conceptual perspective, the using of computers as management tools and support systems, as well as digital cartography, have meant a substantive change in the idea of scale, as data is not taken depending on the scale of representation, but are analytically chosen to make representation possible at any scale (Figs. 5 and 6).

In the end, modern cartography is supported, to a great extent, on computer, on terrain photography and aerial photography, a technique used in almost the totality of modern existing maps. The use of satellite images in conjunction with their interpretation by computing processes and special analyse techniques given by Geographic Information Systems, are making traditional cartography evolve, where besides representing terrain space, all data and its attributes are taken into account.

In this respect, professionals and researchers linked with geosciences and graphic expression are forced to the use of such tools, always connected with a topographic or/and geodesic net, to achieve in that way a georeferencing of all obtained data, in other words, define and represent a special object in a coordinate system.



Figs. 5 and 6 Several methodical cartographic techniques and terrain satellite images of Guadalajara (Spain). *Source* Cartography Service of the City Council of Guadalajara

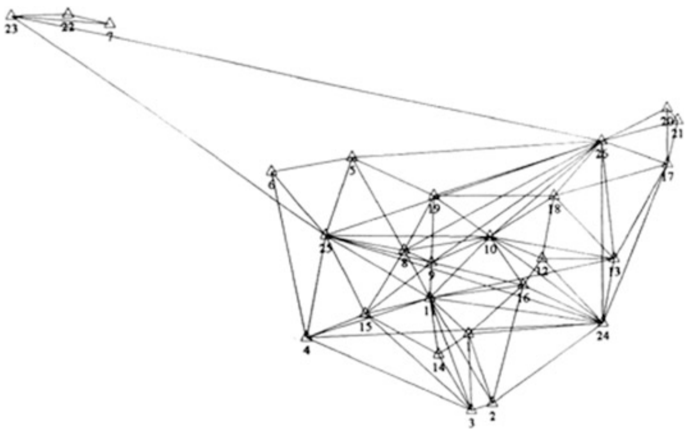
Table 1 Vortex coordinates of the Geodesic Net with the participation of the Basic Net of Guadalajara

Geodesic vertex	No	Latitude	Longitude	UTM		
				Z	X	Y
Pajosa	23	40° 42′ 53.68220″N	3° 17′ 37.26531″W	875.00	475,303.19	4,507,355.38
Cabañas	24	40° 37′ 22.50770″N	3° 06′ 44.17337″W	963.78	490,613.29	4,497,108.52
Andaruelos	25	40° 38′ 57.71484″N	3° 11′ 48.35559″W	664.41	483,473.21	4,500,056.64
Carravieja	26	40° 40′ 36.43721″N	3° 06′ 42.98375″W	964.40	490,648.77	4,503,088.21

In the application of these methodologies made for the reviewing of the Town Planning Plan of Guadalajara (*Plan de Ordenación Municipal de Guadalajara),* the most necessary was, the execution of topographic works that allow any data georeferenciation. It was clear that the resultant cartography was going to be the basic element upon which the Town Planning was to be supported, and thus, the technical quality should be the determinant factor during all process.

For all the territory aimed to plan, the System of Reference chosen was named ED 50 (European Datum 1950). The geodetic head of the vortexes, obtained from High Precision Levelling lines, were referred to average see levels defined by the Tide Gauge Station (Mareógrafo Fundamental), in Alicante. The execution of the action zone or terrestrial area of work was limited to a block of approximately 7000 ha, although a photogrammetry flight comprising the complete foreground was made.

In this context, a trigonometric net linked with the Basic Net of 26 vortexes—from which 22 were new monumentation and 4 belonged to the National Geodesic Net—were constructed to set vortex coordinates. These are: Carravieja, Cabañas, Pajosa and Anderuelos, whose coordinates are in Table 1.



Graph 1 Topographic Net of Guadalajara. *Source* City Council of Guadalajara

The secondary net is made by 10 polygons and composed by a total of 90 nails. These polygons are connected to the vortexes which enter the Basic Net calculation, creating a unique block defined in the Topographic Net of Guadalajara.

Their distribution as well as their coordinate relation is reflected in Graph 1.

For the observation of the Basic Net, GPS receivers Trimble 4000 SSE Geodetic Surveyors were used—obtaining a total of 100 baselines—, and for the secondary net, the Total Station DTM-330 by Nikon was chosen. The calculation and compensation were made in harmony with net dimensions and characteristics and by the adequate programmes in each case, allowing homogeneous block compensation by the method of least squares. The application used in the calculation and compensation of the NET is GPSSURVEY, from the same company as GPS receivers, of highly recognised reliability and precision (Table 2).

Made by the Basic and Topographic Net, each preliminary cartographic work was made for the purpose by photrogrammetry flights at a scale of 1/20,000 and 1/5000 respectively. The first of them was useful for the production of rough drafts 1/5000 scale, and the second to the restitution process made at 1/1000 scale. The longitudinal and transversal coverings were of 60 and 30% respectively. In both cases, a precise and suitable for Management Plans support analytic cartography was drawn up.

3 Georeferencing

Once the cartography was made, we could obtain a real representation of a geographic space, referred to a common coordinate system which allows interrelation of any data contained in the cartographic space.

Table 2 Vortex coordinates of the Basic Net of Guadalajara

Geodesic vertex	X	Y	Z
1	487.110, 423	4.496.803, 937	784, 715
2	487.691, 989	4.494.486, 290	914, 396
3	487.150, 130	4.494.263, 109	920, 015
4	482.917, 766	4.496.700, 214	641, 177
5	484.195, 095	4.502.624, 968	667, 295
6	482.077, 532	4.502.175, 100	701, 787
7	477.849, 940	4.507.063, 828	843, 869
8	485.496, 302	4.499.561, 304	667, 640
9	486.206, 119	4.499.152, 089	709, 428
10	487.715, 254	4.499.970, 526	736, 609
11	486.138, 165	4.497.984, 369	741, 854
12	489.055, 468	4.499.237, 966	786, 298
13	490.946, 703	4.499.211, 390	878, 705
14	486.330, 964	4.496.121, 057	741, 436
15	484.462, 355	4.497.465, 542	680, 942
16	488.540, 060	4.498.387, 470	785, 038
17	492.398, 739	4.502.356, 620	965, 388
18	489.371, 595	4.501.350, 268	736, 517
19	486.273, 667	4.501.326, 804	705, 737
20	492.429, 197	4.504.149, 784	797, 247
21	492.716, 988	4.503.753, 276	819, 851
22	476.788, 467	4.507.355, 376	867, 430
23	475.303, 193	4.507.355, 376	875, 000
24	490.648, 770	4.497.108, 521	963, 776
25	483.473, 207	4.500.056, 638	664, 406
26	490.648, 770	4.503.088,207	964, 400

Source City Council of Guadalajara

The establishment of a coordinate system of Official Reference, based on a Geodesic System determined by some mathematical parameters (Datum, ellipsoid of reference) and the application of a Cartographic Projection System allowed us to transform the curved terrestrial surface into a flat one.

Currently and by virtue of the Royal Decree 1071/2007, two Geodesic Systems of Official Reference coexists. Until that moment, the Geodesic System adopted was the *ED50 (European Datum 1950)* and its cartographic projection was that of the *UTM (Universal Tranversa Mercator)*. However, the new Satellite Navigation Systems (GNSS), as the GPS, the GLONAS and the future European System GALILEO, have gradually developed modern global geodesic reference systems that allow high precision and homogeneity of positioning and navigation, not only at national level but also at European one. This leads us to adopt a Geodesic System of Official Reference, the *ETRS89 (European Terrestrial Reference System 1989)*, European

Terrestrial Reference System 1989, keeping the same UTM cartographic projection system. The Royal Decree, in its second transitory provision, establishes that cartography compilation and publishing and geographic and cartographic information databases, produced or updated by Civil Services, should be done in this new system from the 1st January 2015 on. From this date on, everything should be compiled and published in any of the two systems, ED50 or ETRS89, provided that surveys of the former (ED50) contain references of the latter (ETRS89).

In this regard, any infrastructural, architectural and urban project must be supported on a coordinate system to elaborate plans and maps on which the project is supported and with which the territory could be adequately ordered, planned, reconsidered and managed, allowing undertaking solutions for social, environmental, urban problems or of any other kind.

In the field of planning, the support of a topographic and/or geodesic net turns to be fundamental, as it allows the perfect development of any of the Sector and Execution Units of a Land Management Plan. It makes easier centimetre fitting and coincidence during the material execution of works and helps the structural and infrastructural development needed in any project related with changes in space.

On one hand, we make use of the topographic survey correspondent to the real state of the terrains made by the urban sectors and, on the other, of the urban development map provided by the Land Management Plan approved; both referring to the implemented topographic net. It should be enough to analytically—or by using CAD techniques—insert, the first upon the second to check the perfect fitting of each point, line and polygon and the shape of its geometry (Fig. 7).

The georeferencing of every real estate, plot or land which take up this territory allows geometrical connections of localization, extension, dimension, vicinity, proximity, access or superposition, among others, to turn the geographic space into a central element of different databases containing any territory and which is provided by the Geographic Information System (GIS).

4 Geographic Information Systems (GIS)

In this regard, the GIS are a whole of georeferenciated data, of analysis methods and computing applications that allow managing and which provide information about a cartographic support; either maps, plans or topographic surveys. Thus, the functionalities of GIS are made up from capture, storage, analysis—including management and modelling—and visualization of georeferenciated data.

Digital and georeferenciated data—through the connection that Georeferenciated Information Systems are able to establish with alphanumeric data—turns to be "intelligent" and enrich any information system based on relational tables (Bosque 1997).

One of the main advantages of the use of those systems with regard to that of ordinary databases is the capacity of integrating great quantity of information from various sources and of making a complex spatial analysis of the information. All this data keeps the same situation, dimension and volume, adding to the

Fig. 7 Fitting of the georeferenced urban sector upon the cartographic Local Land Management Plan. *Source* Cartography Service of the City Council of Guadalajara (Spain)

customary relational operations the correspondent building, plot or land plan or map involved in the process, as well as the zoning or urban classification in which they are included.

The possibility of access, through a graphic representation, to the relative attributes or parameters of buildability, allow us to totally control the organization of a certain territorial demarcation. This is how the geographic space is turned into a key element within the entity-relationship model of spatial databases, also known as geodata.

5 GIS Special Data

The obtaining of spatial data or geodata is the first work to be made when establishing a Geographic Information System, being the most expensive and time-consuming phase. Information sources might be diverse, as previously existing plans on papers (analogical information), statistical information, census, land registry, natural, cultural or touristic inventory, etc. In the same way, geodata might be also obtained from the reusing of information generated in the carrying out of any project in the territorial field (roads, channels, irrigation transformations, etc.).

All the same and using a depuration, digitalization or georeferenciation process from the obtained information, basic geodata of a territory—whose geometric and descriptive properties must always be taken into account—might be obtained.

The former (geometrical ones) are closely related with the concept of georeferenciation, it means the geodata must be related with a reference system of local or general coordinates, which permits us to know the location of *punctual elements*—such as companies, farms, monuments, buildings, trees…—, or *linear elements*—such as reads, paths, agricultural protected areas… It means that location, form and extension are the pillars of the information provided by spatial data and geodata.

The latter (descriptive ones) are linked with the characteristics of what they represent, such as population distribution in a territory, number of workers, type of land usages… These properties might be simple numeral values.

However, when it is expected to make territorial analysis of a developing area to face a decision making process, it is necessary to count on more specific information that must be generated, given that it is not ordinarily available.

6 Conclusions

Advances experienced in the methodological processes for cartography obtaining have turned to be essential for the representation and precise knowledge of territory.

Thanks to georeferenciation, the connection among diverse cartographic plans and the combination of different thematic geodata to create a whole map of various topics in a layer system is possible. Likewise, database techniques, besides information storage, allow carrying out queries about spatial data and geodata, based on geometry and its descriptive information.

The obtaining and integration of Geographic Information System components permits the acquisition of cartographic information, map digitalization, database management, geographic analysis, image processing, statistical analysis… and finally, it establishes the foundations of any decision making process.

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Virtual Reality as a Tool for Emotional Evaluation of Architectural Environments

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Abstract The methodology and results of a preliminary study that used virtual reality environments and surveys to analyze the emotional influence of color palettes in an interior space is exposed. Nine chromatic tones were selected and applied into a Virtual Reality architectural environment. Thirty trials were made with users who answered questionnaires about emotional response and overall assessment of the space during the simulation. The results of this work may be of interest for architects as the opportunity to correlate color ranges used with emotional response and appreciation of space by users facilitates design criteria adapted to the needs of people.

Keywords Virtual reality · Architectural visualization · User centered design

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1 Introduction

The notion that man has about the space around him is discussed since the beginning of philosophy, leading to multiple theories and definitions of the concept "space". While at the beginning the discussion dealt with physical and mathematical concepts of the physical dimension of man, psychologists added emotional relationship as a fundamental component in the studies of space. The perception of space is a complex process involving many variables, the world we perceive is not common to us all, but is the product of our motivations and previous experiences (Norberg-Schulz 1975).

In recent years, architectural research is expanding its traditional boundaries, to go into areas that until now have been studied by environmental psychology. Psychologists, ergonomists and neurologists have conducted numerous studies that support the conclusion that architectural space influences people in an emotional way (Ulrich 1984, 224–225). This findings have led into disciplines (Environment-Behavior, User-Centered Design, Evidence-Based Design…) which, from an experimental point of view, allow to quantify the influence of spaces and elements in people behaviour, so this knowledge can be applied during architectural design stages focusing on the emotional needs of users (Sergison et al. 2013, 61–84).

Usually, studies in this area have shown visual stimuli with variables to be analysed to subjects in order to record their answers. In an ideal situation, the stimuli would be real architectural environments where the subjects fully perceive the space. In practice, these studies show the subjects drawings, photographs (Dijkstra et al. 2008, 268–277), collages, computer graphics or videos (Heft and Nasar 2000, 301–322) being the validity of the responses conditioned to the capacity of recreate the space by some users who, normally, are profane in the field of "think spaces". This limitation is especially evident when aesthetic or emotional factors are evaluated ("how I like it", "How do I feel"…) as they require special intellectual skills to evoke the subtleties and feelings of the space to assess.

However, in recent years it is being used virtual reality environments to present stimuli (Franz et al. 2005, 165–172; Castronovo et al. 2013; Tutt and Harty 2013, 2–4). This new display format has several important advantages. On the one hand, and compared to traditional methods (drawings, renders…), it allows user to move freely through space in a natural way, which greatly facilitates to feel (not just to watch) architecture in first person. On the other hand, with regard to the visualization of spaces, allows the visit of distant, missing or not built architectures, allowing also easy modification of isolated variables (dimensions, finishes…). All this makes it ideal for the development of experimental studies on perception of space.

In this communication the methodology and results of a preliminary study in which virtual reality environments and questionnaires were used to analyse the emotional assessment of users to an interior space is exposed.

Two main objectives are sought. First, to observe the goodness of using real-time, interactive, immersive stereoscopic environments by Head-Mounted Displays (commonly known as "virtual reality glasses") for the presentation of the architectural scenarios to be evaluated by the user. Second, applying this technology to analyse, through experimental study, the influence of color on the perception and emotional assessment by the user to an architectural space.

2 Materials and Methods

As an environment to be evaluated a breastfeeding room was chosen because it is neither overly familiar nor uncommon space, combines both functional and emotional requirements and allows individual use. A breastfeeding room integrated in a Neonatal Intensive Care Unit of a hospital was selected. The room consisted of a communal space with three feeding stations with chairs and side tables, a separate independent chair behind an opaque screen for privacy, a bench with baby changing, sink and bottle preparation area, and a restricted room dedicated to storage of milk and formula preparation by staff.

As a variable to study color was chosen, being an objective factor, measurable, changeable and, according to the literature, related to emotional response (Tofle et al. 2004). Eight color ranges were selected from equidistant hues in the NCS scale, plus a desaturated color range. In interior design it is common to use color palettes consisting of three, four or five harmonic colors to provide greater visual richness to the space from a base tone. Thus, each of the nine color ranges contains three colors, keeping hue (the independent variable) and saturation, and varying brightness to 40, 70 and 95% (Table 1) using the lighter color in walls, the middle in the floor and pillar, and the darker in doors and furniture under counter.

The floor of the room was drawn in AutoCAD and exported to SketchUp for three-dimensional modeling and addition of furniture. The three-dimensional model was exported to the game engine Unity3D where textures and colors of the nine versions of space, direct and indirect lighting and interactive first-person movement were incorporated. By using the Oculus SDK PlugIn for Unity, nine viewable stereoscopic interactive virtual environments were created to be displayed by the HMD Oculus DK2 and controlled by joystick or keyboard (Fig. 1).

A questionnaire to be answered by users while browsing the different Virtual Environments was designed. A first section consisted of demographic data (gender, age, children…) and a second section consisted of emotional response and assessment of space by fivepoint Likert scales (−2 strongly disagree, −1 disagree, 0 indifferent, +1 agree, +2 totally agree). First question was "*This lactation room seems…*" for adjectives *Functional/Cozy/to have a Good design/Spacious/Simple/Sunny*, emotional concepts that had proven to be essential for the assessment of lactation rooms in previous study by Kansei Engineering. Second question was "*This lactation room gives…*" for the emotions *Stress/pleasure-Wellbeing/Safety*, concepts considered important for the emotional evaluation of

Table 1 Color ranges used with color coding on the NCS standard

Selected chromatic tones							
Environment	Hue	Color	NCS code	Environment	Hue	Color	NCS code
Environment 0	Grey	Light	S 6000-N	Environment 5	Pink	Light	S 6030-R30B
		Middle	S 3000-N			Middle	S 3030-R30B
		Dark	S 0500-N			Dark	S 0530-R30B
Environment 1	Green	Light	S 6030-G30Y	Environment 6	Blue	Light	S 6030-R80B
		Middle	S 3030-G30Y			Middle	S 3030-R80B
		Dark	S 0530-G30Y			Dark	S 0530-R80B
Environment 2	Yellow	Light	S 6030-G90Y	Environment 7	Cyan	Light	S 6030-B30G
		Middle	S 3030-G90Y			Middle	S 3030-B30G
		Dark	S 0530-G90Y			Dark	S 0530-B30G
Environment 3	Brown	Light	S 6030-Y30R	Environment 8	Turquoise	Light	S 6030-B90G
		Middle	S 3030-Y30R			Middle	S 3030-B90G
		Dark	S 0530-Y30R			Dark	S 0530-B90G
Environment 4	Rojo	Light	S 6030-Y80R				
		Middle	S 3030-Y80R				
		Dark	S 0530-Y80R				

Fig. 1 Three screenshots of the Virtual Environment

Fig. 2 User with Virtual Reality HMD during trial

space, according to the literature (Mehrabian and Russell 1974). Finally it was asked "*I like this nursery room Aesthetically…*" and "*If I had to use a lactation room, I wish it was this…*" for purely aesthetic evaluation and the overall evaluation including functionality. At the end, a question of self-evaluation about the goodness of the technology used was included "*State 0–10, how clearly it has allowed him to understand the previous display space.*"

During the preliminary phase of the study object of this communication, thirty subjects visualized the Virtual Environment in nine color combinations, using stereoscopic HMD Oculus Rift VR DK2, moving freely during an average time of 5 min while they answered the questionnaire (Fig. 2). During the experience it was said to the participants to assess the environment considering that it was a nursing room and imagining they were going to use it.

3 Results

Data was treated statistically. In terms of population data, 66% of respondents were male versus 33% female, mean age comprised under 40 (76.7%), 50% had children and 43% had used actual lactation rooms. The self-assessment indicated that they understood the space into a Level 9 of 10. The assessed values for each variable were z-standardized so that simplifies comparative interpretation between both color ranges and among concepts (Table 2).

Table 2 Z-standarizes means, arranged by color

Means—standardized values—by colors											
Environment	Functional	Cozy	Good design	Spacious	Simple	Sunny	Relaxing	Pleasure/wellbeing	Safety	Aesthetic valuation	Global valuation
0 Grey	−0.22	−0.71	0.17	−0.38	0.15	0.08	0.05	−0.53	−0.49	−0.55	−0.26
1 Green	−0.49	−0.12	−1.18	−0.38	0.15	−0.33	−0.74	−0.53	0.64	−0.18	−0.26
2 Yellow	−0.49	0.28	0.51	0.38	0.64	0.49	0.85	0.18	−0.49	0.55	0.39
3 Brown	0.6	−0.12	−0.17	0.77	−1.33	−0.33	0.32	0.88	0.26	0.18	0.07
4 Red	0.05	−0.12	−0.17	−0.38	0.15	−1.15	−0.74	−0.88	−0.49	−0.91	−0.26
5 Pink	0.6	0.28	0.51	0	0.15	0.49	0.32	0.53	0.64	0.91	0.07
6 Blue	−0.49	0.67	−0.51	0	−0.34	0.49	0.85	0.53	0.26	0.55	0.07
7 Cyan	0.05	−0.12	−0.17	0	0.64	−0.33	−0.21	0.18	−0.11	−0.55	−0.26
8 Turquoise	0.6	0.67	0.85	0.38	−0.34	0.49	−0.74	0.18	0.26	0.55	0.72
Total	0	0	0	0	0	0	0	0	0	0	0

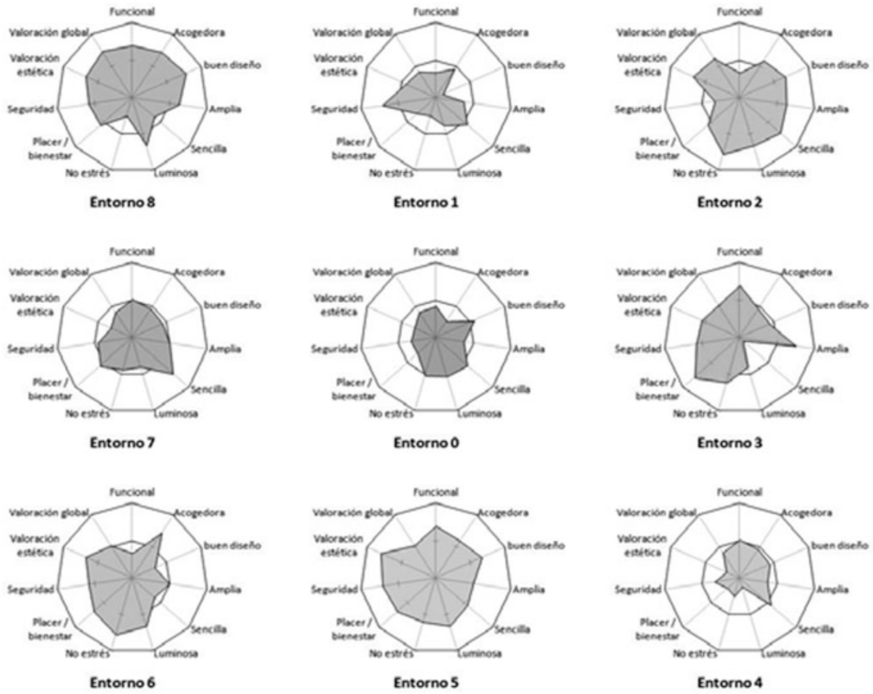

Fig. 3 Radar chart showing level of variables for each environment

Colors that highlight aesthetic evaluation are pink (environment 5) followed by vanilla yellow (environment 2), cornflower blue (environment 6) and turquoise (environment 8) while the lower valuation goes to red (environment 4) followed by cyan (environment 7) and white (environment 0).

To sort the information shown in the contingency table two sets of radar charts are presented. The first shows the values of each variable independent for each environment, so it can be checked the value that each color obtained in the different concepts studied (Fig. 3). It shows that the tone with better overall valuations is pink (environment 5) which has not had negative score in any way, followed by vanilla yellow (environment 2), cornflower blue (around 6) and turquoise (around 8), according to the aesthetic value indicated above. Similarly, the hue with worse scores is red (environment 4) followed by green (environment 1) and white (environment 0). The second set of graphs shows the values of each environment for each independent variable, so that allows to visually compare to what extent affects every hue for an individual feeling (Fig. 4).

Subsequently, correlations between variables were sought, considering the non-parametric correlation coefficient by Spearman' Rho. The results (Table 3) indicate correlations with significance at the 0.01 level linking mainly *Aesthetic valuation* with *Cozy* feeling and perception of *Pleasure/Wellbeing* and *Global*

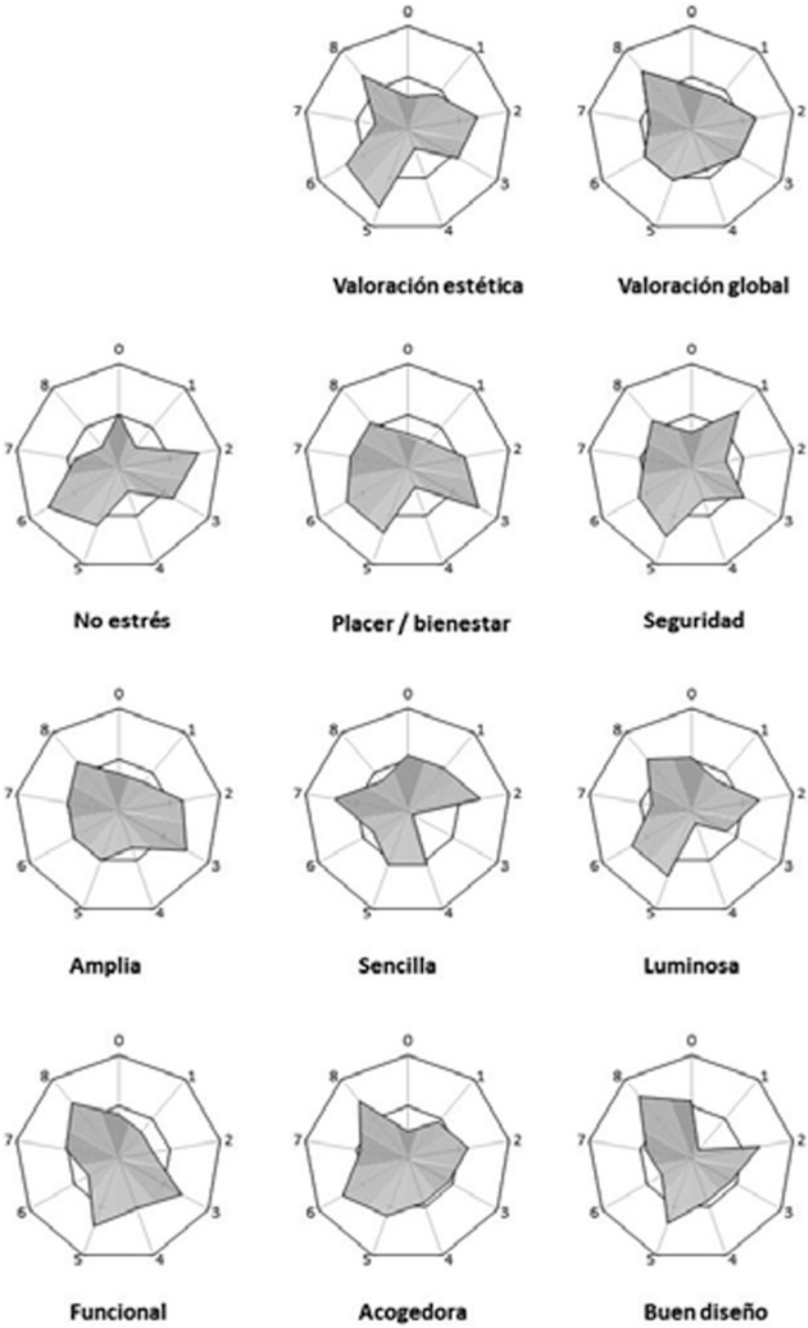

Fig. 4 Radar chart showing level of environments for each variable

Table 3 Correlations between variables and assessments

Non parametric correlations—Spearman's Rho	Affective variables						Emotional variables			Preference	
	Functional	Cozy	Good design	Spacious	Simple	Sunny	Relaxing	Pleasure/wellbeing	Safety	Aesthetic valuation	Global valuation
Functional		−0.01	**0.54****	0.36	−0.04	−0.32	−0.35	0.09	0.21	0.07	0.17
Cozy	−0.01		0.35	−0.10	0.10	0.37*	0.26	**0.52****	0.16	**0.69****	**0.63****
Good design	**0.54****	0.35		0.25	0.34	0.21	−0.02	0.13	0.09	0.37*	**0.47****
Spacious	0.36	−0.10	0.25		−0.14	−0.30	−0.13	0.14	0.14	0.13	0.11
Simple	−0.04	0.10	0.34	−0.14		0.12	−0.02	−0.02	0.00	−0.10	0.27
Sunny	−0.32	0.37*	0.21	−0.30	0.12		**0.53****	0.38*	0.40*	0.40*	0.24
Relaxing	−0.35	0.26	−0.02	−0.13	−0.02	**0.53****		0.44*	0.01	0.29	−0.01
Pleasure/wellbeing	0.09	**0.52****	0.13	0.14	−0.02	0.38*	0.44*		**0.51****	**0.55****	**0.65****
Safety	0.21	0.16	0.09	0.14	0.00	0.40*	0.01	**0.51****		0.34	0.38*
Aesthetic valuation	0.07	**0.69****	0.37*	0.13	−0.10	0.40*	0.29	**0.55****	0.34		**0.48****
Global valuation	0.17	**0.63****	**0.47****	0.11	0.27	0.24	−0.01	**0.65****	0.38*	**0.48****	

**Correlation at level 0.01
*Correlation at level 0.05

Table 4 Factor analysis of the nine variables

Rotated component matrix[a]			
	Component		
	Factor 1	Factor 2	Factor 3
Pleasure/wellbeing	**0.872**	0.177	−0.043
Sunny	**0.766**	−0.338	0.109
Cozy	**0.630**	−0.067	0.343
Safety	**0.627**	0.345	−0.259
Relaxing	**0.602**	−0.401	0.022
Functional	−0.063	**0.876**	0.163
Spacious	−0.024	**0.763**	−0.091
Simple	−0.112	−0.141	**0.821**
Good design	0.307	0.374	**0.764**

valuation with a *Good design* in addition to the previous two. Other statistically significant correlations link *Functional* with *Good design*, *Sunny* with *Relaxing* and *Pleasure/Wellbeing* with *Cozy* and *Safety*.

Then factor analysis was performed to identify the underlying factors that explain the pattern of correlations within the set of variables studied. The extraction method was principal components analysis with Varimax rotation. The results (Table 4) indicate that the nine variables could be simplified into three integrators factors:

- Factor 1: This includes *Pleasure/Wellbeing*, *Sunny*, *Cozy*, *Safety* and *Relaxing* variables. Correspond to the component relating to Wellbeing and explains 30% of the total variance.
- Factor 2: This includes *Functional* and *Spacious* variables. Correspond to the component on the Functional and explains 22% of the total variance.
- Factor 3: This includes *Simple* and *Good design* variables. Correspond to the component on the Aesthetic and explains 16% of the total variance.

These three factors of space (wellbeing, functionality and the aesthetics) are latent variables that explain 68% of the total variance obtained in the questionnaire responses. A new search for correlations between them and the aesthetic and overall assessments of space (Table 5) shows that the perception of wellbeing is directly linked to both high aesthetic and global values of the space, as it presents a statistically significant correlation in the level 0.01. Reducing the variables to its main underlying factors allows ordering the mean values of each color range on independent axes showing the degree of influence of each environment regarding the three components. In this case (Fig. 5) different color ranges were set according to their influence on Factor 1 (wellbeing) and Factor 2 (functionality) axes so that it can be displayed the influence of color in the perception of both factors in user's mind.

Table 5 Correlations between factors and assessments

Correlations—Spearman' Rho						
		Factor 1	Factor 2	Factor 3	Aesthetic valuation	Global valuation
Factor 1	Wellbeing		−0.064	0.034	**0.658****	**0.558****
Factor 2	Functionality	−0.064		0.011	0.092	0.179
Factor 3	Design	0.034	0.011		0.177	0.403
Aesthetic valuation		0.658**	0.092	0.177		0.484**
Global valuation		0.558**	0.179	0.403	0.484**	

**Correlation at level 0.01

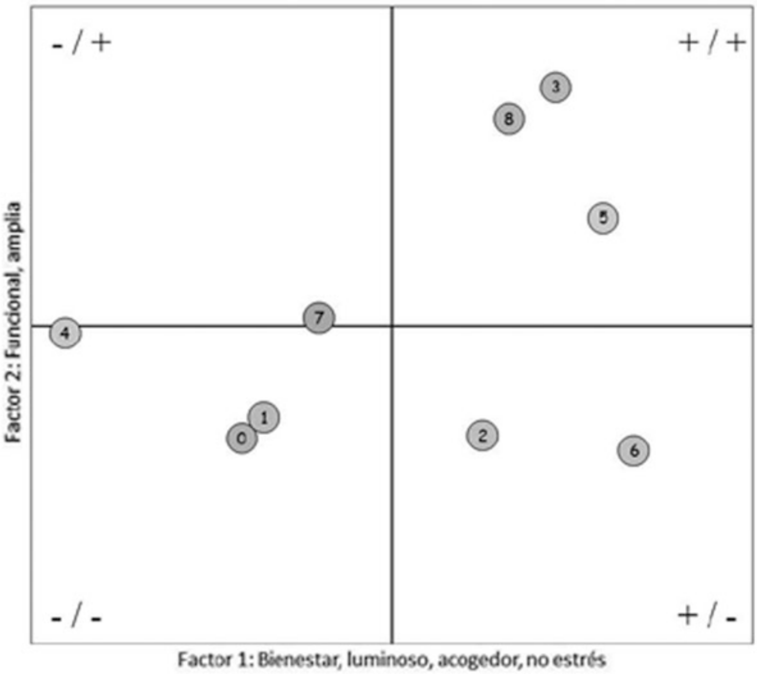

Fig. 5 Chart showing of the influence of each environment (0–8) in the Factor 1 Factor 2 axes

4 Conclusions

This preliminary study allows us to extract two types of conclusions. On the one hand, the use of interactive stereoscopic realistic first-person walkable architectural environments has proved to be successful both in its development process, not too far from the usual process of making digital architectural images and carried out by architects without specializing in programming, and in the response from users who highly appreciated the experience and the feeling of architectural immersion both in questionnaire and informal feedback during the study.

On the other hand, in terms of results on the emotional perception of color ranges two clarifications about the results have to be made. First, we must be aware that being a preliminary study the sample is not high, N = 30, although it is intended to gradually increase it over time. Second, the user response is to be understood referring to a specific space provided, and considering its use as lactation room, with the constraints in terms of privacy and tranquility that these rooms require. Any extrapolation to spaces with different dimensions, configurations or uses must be made with caution.

With this in mind, the study reveals some interesting results. First, as shown in Table 2, the hues with better aesthetic value are pale pink followed by cornflower blue, vanilla yellow and turquoise, being the first three ones very common colors in children's rooms, and the fourth a surprise. The worst assessments are for red followed by white and cyan. Regarding the global assessments including functionality, logically trends continue, but values moderated (Fig. 4). Those who expected simple color selection formulas should be disappointed, as it can be seen that valuations are not distributed according to specific tonal ranges. So, are both high and low values in both cold and hot hues, either in bluish, greenish or reddish tones. A slight variation in hue can become a success in failure when selecting a tone, which exemplifies the complexity of the study and application of color in architecture.

Second, the user correlates a space being cozy and giving wellbeing to the best aesthetic and global ratings (Table 3). Cornflower blue, turquoise green, pale pink and vanilla yellow highlight in *Cozy* and, again, peach orange, cornflower blue and pale pink on *Wellbeing*. White and Red stand negative on these issues.

Third, user simplifies the semantic space in three axes relative to *wellbeing, functionality* and *aesthetics* (Table 4), emphasizing the transmission of wellbeing as a decisive factor when it comes to positively assess the space at an aesthetic level and including the design factor in the overall assessment (Table 5). Functionality of the space is not taken into account (at statistical level) by the user when valuing.

Therefore, and with the qualifications noted above, it seems appropriate to consider that spaces requiring to be perceived as welcoming and giving a certain feeling of wellbeing (lactation rooms, waiting rooms or hospitalization room in healthcare buildings, for example) should be designed in pale pink or blue tones or, if desired not stress the child element, in peach or vanilla tones, instead of the more than usual white.

Future works similar to this one, focusing in different spaces and uses, may be of interest for all architects and designers as they enable correlations between color ranges, emotional response and positive appreciation of spaces providing design criteria adapted to the real needs people.

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Herman Hertzberger: From Amsterdam's Town Hall Competition to "Centraal Beheer" Office Building

Julio Grijalba Bengoetxea and Rebeca Merino del Río

Abstract The project process that led to the materialization of "Centraal Beheer" Office Building, which should be considered as one of the masterpieces of Dutch Structuralism, started with the proposals for the competitions of the town halls of Valkenswaard and Amsterdam. The study and graphic comparison between the notes and sketches for the competitions of Valkenswaard and Amsterdam and the first "Centraal Beheer" drawings, will allow us to understand the evolution of Herman Hertzberger's thinking in a certain historical period, which was characterized by the continuous disturbances and social demands, and how this evolution meant a change in his graphic representation.

Keywords Herman Hertzberger · Amsterdam's Town Hall Competition · "Centraal Beheer" office building

The initial admiration that arises when the built work of Herman Hertzberger is faced grows as the deep ideology that encloses is discovered after reading his main written oeuvres. The trip through his legacy becomes then in a research and exploration journey around his written and built production. Thus, the access to the different archives throughout various cities of the Netherlands becomes an exceptional resource in order to study in depth his graphical and documental production.

From the gathered documents of the different archives, this research work is undertaken in which the theoretical speech is complemented and supported of the graphical analysis around one of the key works of Herman Hertzberger, the "Centraal Beheer" office building. By taking as a start point the sketches and plans gathered and catalogued, it is proposed a reconstruction of the project process that eventually led to

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the materialization of "Centraal Beheer" by using the study of the graphic mechanisms employed by Herman Hertzberger as the instrument of approach to the form.

1 Valkenswaard's Town Hall Competition: An Intentions Exhibition

In the beginning of 1967, the City Council of Valkenswaard (the Netherlands) organized an ideas competition for the design of the new headquarters of the institution in Valkenswaard. Herman Hertzberger, who formed part since 1959 of the editors' team of the Dutch architectural journal *Forum*, decided to enter for the competition with a proposal clearly linked with the thought developed by Team X. Precisely, it is during this period in *Forum* when he started to strengthen his friendship with Aldo van Eyck who even invited him to attend to the Team X meetings held in Berlin in 1965 and Urbino (Italy) in 1966. The influence not only of Aldo van Eyck but also of other authors such as Jaap Bakema, both *Forum* editors, produced an evolution in Herman Hertzberger's ideology, which seemed to reach its crowning moment at the end of the sixties decade.

The proposal presented by Herman Hertzberger for Valkenswaard's Town Hall Competition was published in four journals: *Tijdschrift voor Architectuur en Beeldende Kunsten, Bouwkundig Weekblad*, *Bauen und Wohnen* and *Baumeister*. Within this selection, the published article in *Tijdschrift voor Architectuur en Beeldende Kunsten* must be highlighted due to the pictures collection and the great value of them based on what it has been able to reconstruct the project process that led to the proposal for Amsterdam's Town Hall Competition and "Centraal Beheer" company headquarters.

The initial condition of designing an *ex novo* building resulted determinant in the choice and the design of the proposal finally presented. The lack of references in the surroundings and the absence of pre-existing buildings in the site were the conditionings based on what Herman Hertzberger prepared the project for the new town hall by supporting it in a new order. This fact, as we will see, will become the common denominator of the proposals for Amsterdam's Town Hall and "Centraal Beheer" office building. Other significant starting conditionings for the development of the proposal eventually presented were the outstanding magnitude of the project that reached 3755 m^2 accordingly to the programme and the variety of uses that should be accommodated inside the building.

Herman Hertzberger's proposal, under the motto "Het Glazen Slot", presented a built set formed by 28 unities, extendable to 34 unities, juxtaposed in the two directions of the horizontal plane (Fig. 1). In the original design, a central core was generated by means of the joining of four of these unities, which would accommodate those uses that required a larger surface. The apparent stiffness of the generating pattern allowed, however, a wide flexibility in the building adaptation to the site and the disposal of the different spaces.

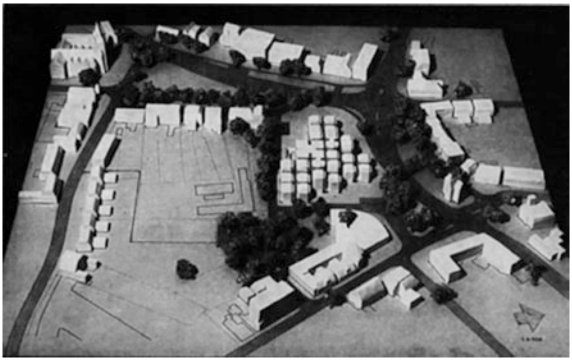

Fig. 1 Herman Hertzberger. Model for Valkenswaard's Town Hall Competition. *Tijdschrift voor Architectuur en Beeldende Kunsten,* no. 5. 1967

Thus, "Het Glazen Slot" became a first research exercise about two fundamental subjects: the scale and the intermediate spaces. Against the increasing dissociation between people and power, which, far from disappear after the Second World War, had continued with profound alterations, Hertzberger justified the design based on an affirmations duality that, to a certain extent, linked with the poetic resources used by Aldo van Eyck: "The Town Hall must be fundamentally anti-monumental in the sense that monumentality is connected with power. The Town Hall must be substantially monumental in the sense that democracy is associated with monumentality" (Hertzberger 1967a, 5:103). In an attempt to bring the building scale to the user, Hertzberger uses the articulation and the extensive growing in order to give response to the programme. Thus, a city-building is generated which results at the same time anti-monumental, in the sense that the unities and the spaces have a reduced size controllable by the user, and monumental, to the extent that the complex acquires a significant scale through the articulation and it becomes an exponent of the whole of users' will.

Nevertheless, the proposal presented certain features that denoted its primitive status, which, as we will see, will progressively disappear in the proposals for Amsterdam's Town Hall and "Centraal Beheer". As it is shown in Fig. 2, the supports reticule that underlies in the plan is not presented in a continuous manner, since the weft is altered in several points disrupted by diverse nature geometries, such as cylindrical bodies, different layout walls, etc. This resource was especially visible in the access and the underground floors, fact that distorted and made unintelligible the structural reticule making difficult the integral reading of the complex. Also in Fig. 2, it is possible to observe how in this first proposal the circulation areas are dissociated from the structure and they acquire a free layout within the floor, remaining subordinated to the geometries of the stay spaces.

This project presented by Herman Hertzberger was not eventually awarded despite being well received by the critics of the different members of the jury who noticed that the solution was "a conscious, talented exponent of the Modern thought" (Hertzberger 1967d, 20:337). The critics in which the jury based on the final verdict was mainly focused on the design functionality, arguing that the project was not in the way to express the idea on the ideological background

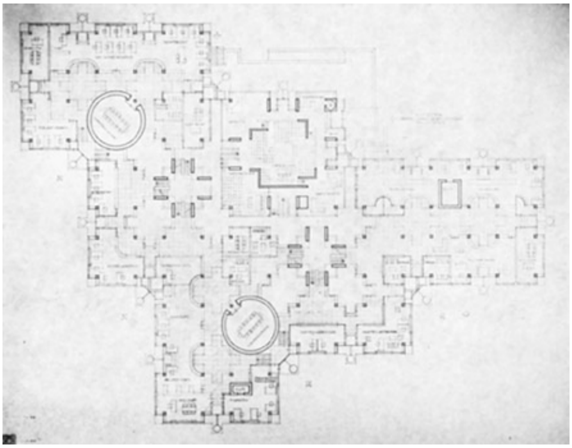

Fig. 2 Herman Hertzberger. Access floor plan for Valkenswaard's Town Hall Competition. *Tijdschrift voor Architectuur en Beeldende Kunsten,* no. 5. 1967

developed. However, taking into account the following affairs and the project finally built few decades later, it seems probable that one of the main causes so that Hertzberger's proposal was not selected was the excess of freedom and interpretability that was given to the users and workers, which run counter to the local authorities' interests.

2 Amsterdam's Town Hall Competition: The Idea in Progress

In November 1967, Amsterdam's City Council organized an International Competition for the design of the new institution headquarters in a public lands placed in the southeast of the historical city flanked by Amstel river and Zwanenburgwal Canal. The competition announcement was surrounded of a great expectation and its worldwide spreading rose Amsterdam's social problems to a higher context. The huge interest that the announcement aroused between different architects around the world caused that a total of 803 entries were received from diverse nationalities.

In that moment, Amsterdam City was in turmoil incited by the revolutionary activity of the collective known as a 'Provos', mainly formed by young people, who claimed a higher participation of the society in the political decisions accordingly to what was happened in other parts of Europe, such as Paris or London. Under this protests underlay the ideology of the *Internationale Situationniste* (Granés 2011), which years before had already put its focus on the revolutionary potential that the young enclosed and whose manifestoes in favour of unitary urbanism and against the society of the spectacle had a deep effect on a sector of Dutch society. The striking and variated forms of protest of certain important figures, between whom we could highlight Roel van Duyn or Robert J. Grootveld, along with the excessive and out of proportion reprisals carried out by the Police caused that part of the population started to sympathize with the postulates defended by the 'Provos'. This fact finally triggered in Amsterdam's Police Chief dismissal, at the end of 1966, and the resignation of Amsterdam's Mayor Gijsbert van Hall, in 1967.

Compared to the competition of Valkenswaard, the announcement of the Amsterdam's Town Hall Ideas Competition meant an especially exciting challenge for those local architects, between whom Herman Hertzberger was, who had experienced at first-hand the riots that had taken placed in the city since the revolutionary young started their activity at the beginning of the sixties. Hertzberger at that moment had just published two of his most significant articles in *Forum* journal, "Form and programme are reciprocally evocative" and "Identity", where his future research lines were mentioned and defined. His proposal, with entry number 173, supposed a great step forward in contrast to the project presented few months before for Valkenswaard's Town Hall.

In this case, the slender published information about the proposal for Amsterdam's Town Hall force us to resort to the original sketches which undoubtedly will allow us to understand not only the evolution of this concrete design but also the project process that led to the proposal for "Centraal Beheer". In Fig. 3, one of the first sketches, is possible to observe the increasing concern of Herman Hertzberger for altering and meaning the reticule. In the proposal for Amsterdam's Town Hall, the structural system evolve from the simple piers framework to a reticules superimposition whose relative movement in the plan and the section gave rise to a diagonal tension clearly appreciable in the interior space of the complex. Moreover, a duplicity of the supports that structured the 'towers' was introduced as an innovation, which allowed that the patterns acquired thickness in plan and spatiality in volume. In contrast to the four piers that shaped the unities of the proposal for Valkenswaard, Hertzberger suggested that, in this case, it were eight the supports that defined the new 'towers' whose squared geometry in the plan would not be distorted due to the tangential location of the piers at one and two thirds of each side.

In the same way as in Valkenswaard proposal, Amsterdam Town Hall proposed an expansive growing system based on the repetition of the 'tower' motif by means of the juxtaposition of the unities in the two directions of the horizontal plane. Eventually, the developed project presented a complex divided in four clearly differentiated sectors because of the weft interruption along four guidelines, which generated four main access streets to the core (Fig. 4). The diverse colour schemes and shades areas used by Hertzberger in this sketch represented the different privacy degrees of the access spaces that led to the core, which comprised a wide range of situations from the uncovered public street to the interior restricted-access 'street'.

Against the presented solution for Valkenswaard, Amsterdam's project developed more widely the intermediate spaces theme which began to acquire own personality because of the steps forward carried out by Hertzberger in other directions. To the extent that the building was configured as a city by means of a 'towers' and 'streets' system, it was searched to alter and stimulate the individuals perception. Thus, the relations between users and between user and environment

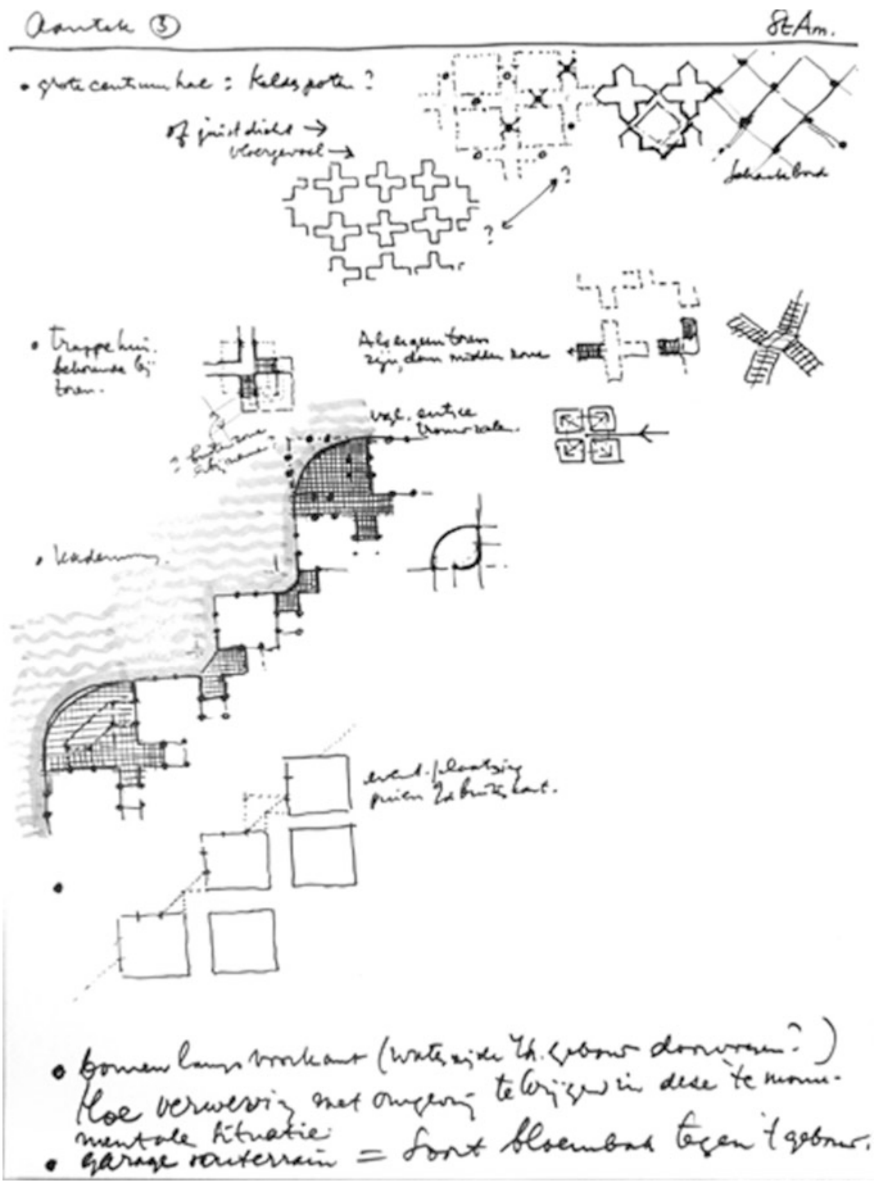

Fig. 3 Herman Hertzberger. Sketch for Amsterdam's Town Hall Competition. Herman Hertzberger's archive

were encouraged, having an spontaneous and daily character as actually it happened in the urban milieu as a result of the interests and needs of each person in a certain moment. Thus, the building became a relations framework that searched to be complemented by means of the use and the interpretation of the whole of users

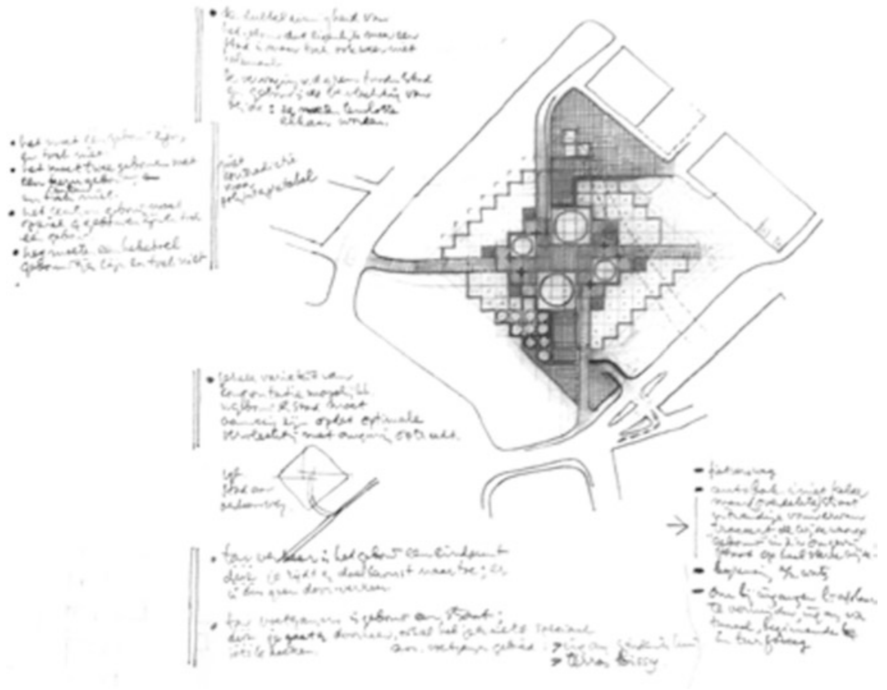

Fig. 4 Herman Hertzberger. Project sketch for Amsterdam's Town Hall Competition (27th of October 1967). Herman Hertzberger's archive

(Hertzberger 1967b). In Herman Hertzberger's words: "Everything we make must be the catalyst to stimulate the individual to play the roles through which his identity will be enlarged" (Hertzberger 1967c, 7:18).

The proximity and influence of Aldo van Eyck as well as of the Team X in the theoretical conception of Herman Hertzberger is obvious as it is possible to observe to the extent that Hertzberger continue the researches concerning the 'in-between' and 'identity' started and developed by the quoted group of architects. However, we should underline that the influence of Aldo van Eyck goes beyond the purely theoretical influence, by introducing in the representative sphere. Both in the solution for Valkenswaard and in the proposal for Amsterdam's Town Hall, the deformation of the weft by means of the superimposition of cylindrical geometries is a clear demonstration of the influence exerted by some of Aldo van Eyck's projects (Frampton 2002). Between these, we should highlight the project for the Driebergen's Church (1964), the Sonsbeek's Pavilion (1966) or Pastoor van Ars Church in The Hague (1962–1969). In the case of the project for Amsterdam's Town Hall, with far larger proportions than the proposal for Valkenswaard, the complex based on the repetition of the tower-unities was interrupted in its central part by a collection of prismatic and cylindrical bodies of high proportions that accommodated the most representative uses, such as the show room or the theatre.

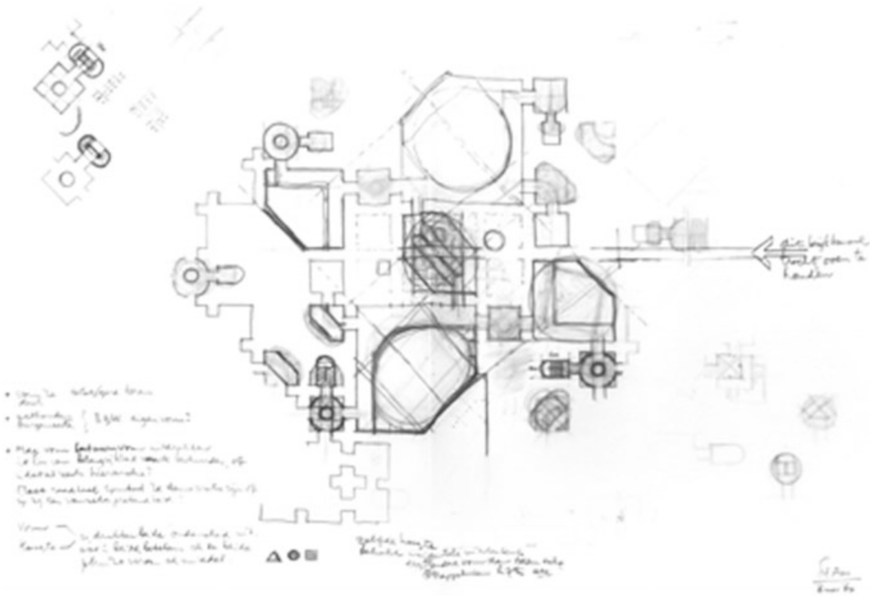

Fig. 5 Herman Hertzberger. Project sketch for Amsterdam's Town Hall Competition (8th of November 1967). Herman Hertzberger's archive

In Fig. 5, it is possible to observe one of the original sketches in which Hertzberger detach the central core of the complex, partially representing the outline of the nearby towers and streets, in order to work with the diverse geometries that comprise it. The treatment and the disposal of the objects, celebrating the streets encounter in the central point of the whole and easing a fluid movement between the different sectors, directly link this project with the proposal presented by Aldo van Eyck for the Protestant Church of Driebergen. At the bottom left side of Fig. 6, it is possible to appreciate two plan schemes, which clearly show these connections.

The solution presented by Herman Hertzberger was not selected to pass to the next phases of the competition. In a first round, the jury selected a total of twenty entries, most of them were in the same design line developed by Hertzberger, fact because of what, some years later, this competition will be remembered as a milestone in the history of Dutch Structuralism.[1] The selection process was marked by the disagreements between the members of the jury, since an important group wished to develop some of the structuralist-design proposals, while the rest of the

[1]The term "Dutch Structuralism", firstly used by Piet Blom, was established few years after because of the use that Arnaud Beerends made of it in the journal *TABK* referring to the emergent movement after de Competition for Amsterdam's Town Hall. This designation was internationally accepted as consequence of its intensive employment in several Arnulf Lüchinger articles in the seventies decade (Strauven 1998).

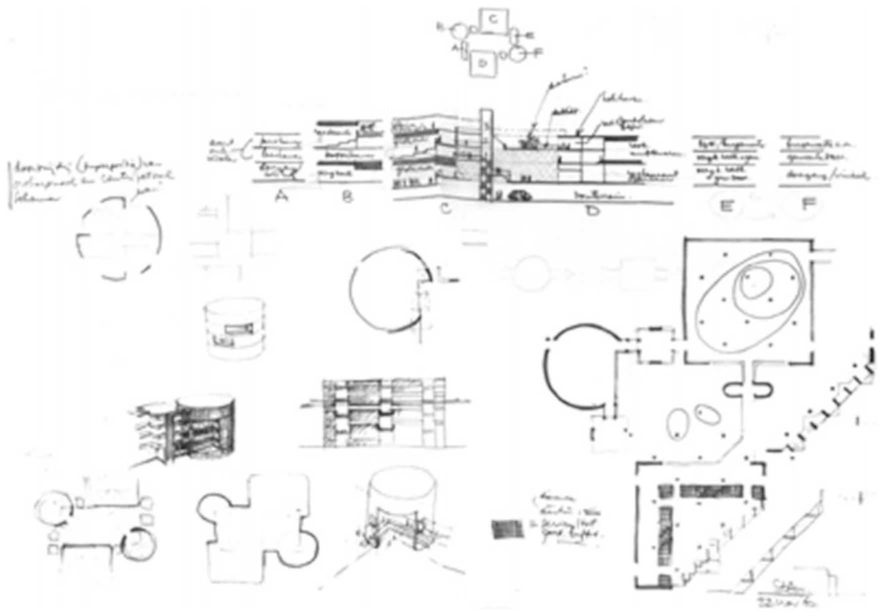

Fig. 6 Herman Hertzberger. Project sketch for Amsterdam's Town Hall Competition (22nd of October 1967). Herman Hertzberger's archive

members cast doubts on the ability and solvency of these projects arguing that the City of Amsterdam was not prepared for the challenge they meant. In the next phase, they were selected seven entries between which the jury eventually chose the project of the Austrian author Holzbauer as the winner of the competition.

3 "Centraal Beheer" Office Building: The Fulfilment of a Long Process

In the first months of 1968, the president and director of the Cooperative Association "Centraal Beheer" J.W. Ruiter, in the name of the affiliate "Pensioen Risico", order Herman Hertzberger's Architecture studio to design the new offices in the city of Apeldoorn (the Netherlands). The company, which in that moment had approximately 650 employees and since its foundation in 1909 had had its headquarters in Amsterdam, decided to move the central offices to the locality of Apeldoorn. The freedom given by the owner in the complex design allowed Herman Hertzberger to put into practice the architectural model in which he had been working for several years. The only premises pointed by J.W. Ruiter were to

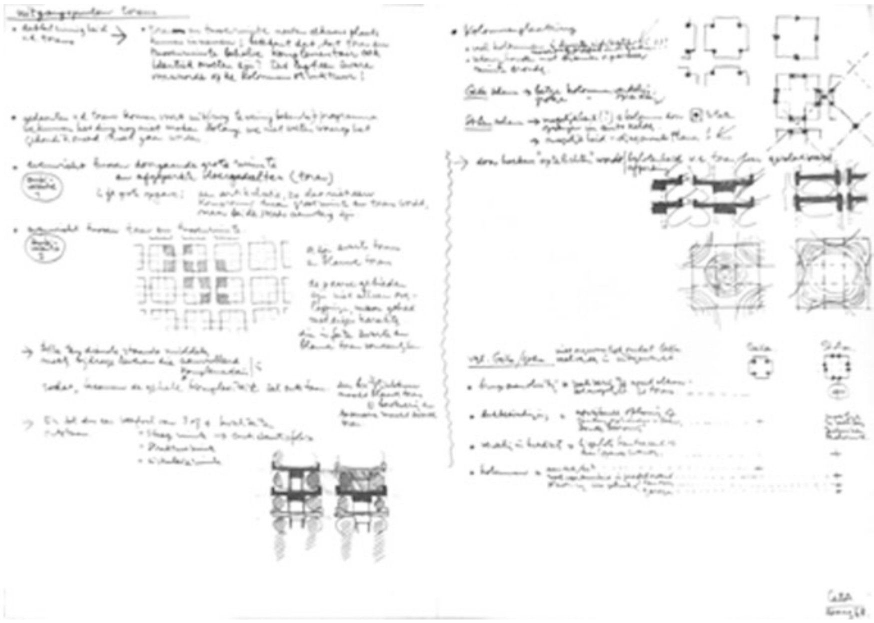

Fig. 7 Herman Hertzberger. Original sketch for “Centraal Beheer” office building project (20th of August 1968). Herman Hertzberger’s archive

take a special care with the preparation and the management, and that the proposal could be built in different stages in order to allow the gradual relocation of the company workers.[2]

The first sketches that we find, which date of summer of 1968, already show steps forward against the ones analyzed in this communication. In the right side of Fig. 7, it is possible to observe how Hertzberger realize a comparison between the developed systems for Valkenswaard and Amsterdam’s town halls with the only intention of justifying the choice of the patterns system against the reticle. This allowed him to define and differentiate two kinds of areas within the weft: the circulation zones and the interpretable spaces. They are introduced two subjects of the utmost importance to understand the existing evolution since the proposal for Valkenswaard: the research about the form and the structure and the polyvalency (Hertzberger 1991). In contrast to the apparent immobility of the previous models, in “Centraal Beheer” the component of the spatial adaptability was introduced. Thus, it is created a system in which a succession of equivalent zones (with an approximated surface of 9 m^2) were delimited by the structural system, where the user or users had full ability to performance depending on the needs and worries in each moment. In the schemes of Figs. 7 and 8, it is possible to appreciate the

[2]Information extracted from the local newspaper of Apeldoorn *Reformatorisch Dagblad* of the Tuesday, 31st of October 1972, p. 6.

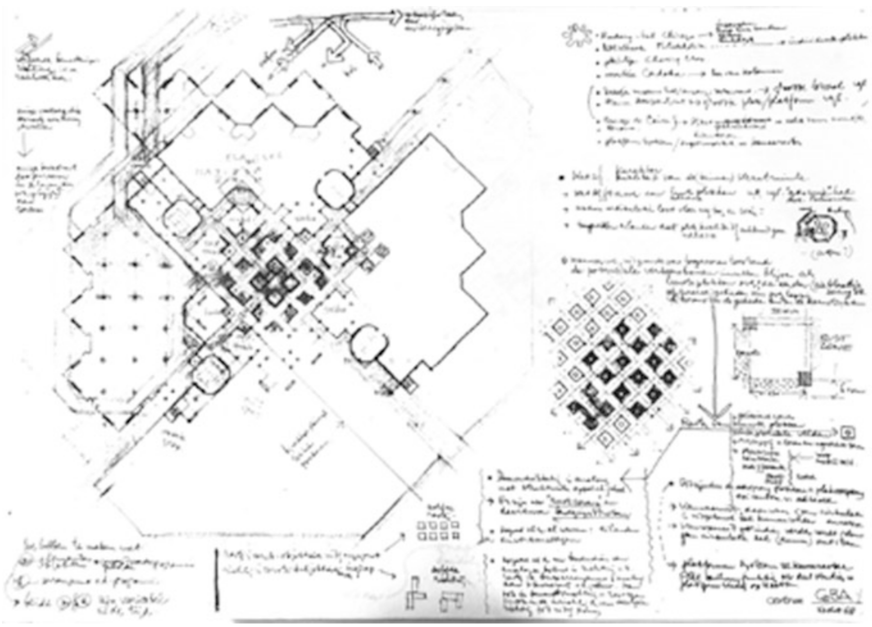

Fig. 8 Herman Hertzberger. Original sketch for "Centraal Beheer" office building project (27th of October 1968). Herman Hertzberger's archive

placement of these interpretable zones within the network of 'towers' and 'streets', as they remain distinguished from the rest of areas by means of a shading.

These innovations in the field of the Architecture appeared in accordance with the researches developed in other disciplines such as the linguistics, the anthropology or the philosophy, between which we should highlight the work of the French anthropologist Claude Lévi-Strauss. Hertzberger, who knew about Lévi-Strauss work, did not hesitate to translate the mainly methodological fundamentals of the Structuralism to the architectural discipline. This adaptation of the structuralist principles as well as the subsequent theoretical and practical development placed Herman Hertzberger as key figure of Dutch Structuralism to the extent that he became one of its main ideologists. The central theme around which he based on and articulated his theories was focused on the reciprocity between form and function. This was based on the distinction between the synchronic and diachronic dimensions of the structures developed by Lévi-Strauss in his main essays, which continued, to a certain extent, the studies carried out by Ferdinand de Saussure concerning the language and its double nature (Badcock 1979). Thus, regarding the relation between form and function, Herman Hertzberger wrote: "In order to have various implications a form must be interpretable in the sense of being able to play a changing role. It must in fact be such that the implications are posed beforehand as hidden possibility, in such a way that they are present as provocation, suggested but not stated" (Hertzberger 1967b, 7:16).

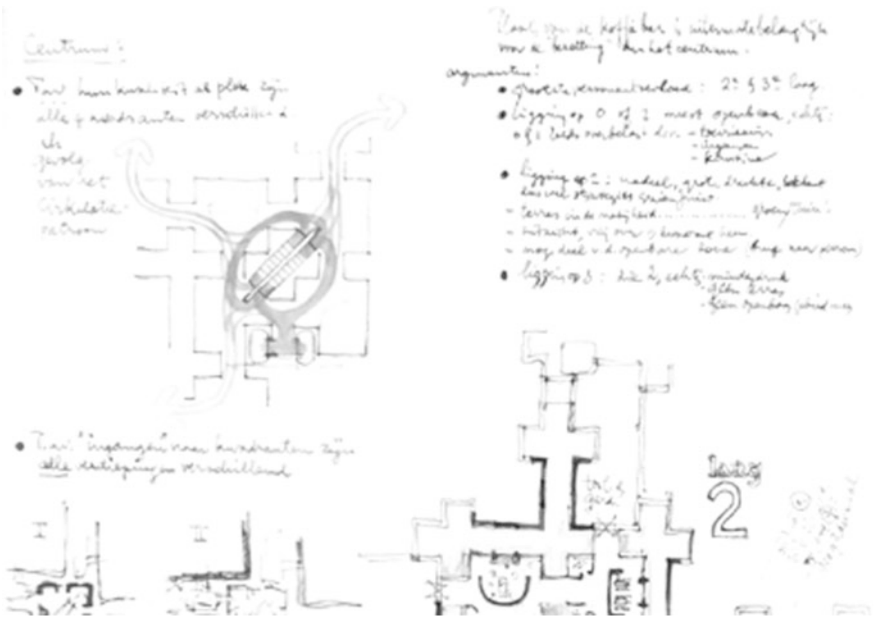

Fig. 9 Herman Hertzberger. Original sketch for "Centraal Beheer" office building project (16th of January 1969). Herman Hertzberger's archive

Compared with the projects for the town halls of Valkenswaard and Amsterdam, the project developed for "Centraal Beheer" company put other fundamental theme into practice that allows us to link this proposal with the ideology of the Situationist International: the labyrinth. Thus, it would be demonstrated that some of the theories of the Situationist International, between which the studies about the psycho-geography and the drift must be emphasized, could influence Herman Hertzberger. The spatial isotropy that characterized the interior space of "Centraal Beheer" must be understood as a conscious attempt to realize a labyrinthine model with all the consequences that it meant for the users (Fig. 9). "Centraal Beheer" is projected in a moment when the continue concessions of the population to the authorities were leading to real loss of rights and decision capability that certain sectors of the population considered intolerable. Against this situation, some of the main figures that took part in the Situationist International proposed new urbanism models in which the individuals become the reference point of the system. Thus, they had the opportunity to learn of the environment they perceived by means of their senses and based on their own conscious, and to alter it through the interpretation. Constant Nieuwenhuys, a Dutch author that formed part of the *Internationale Situationniste* during some years and whose urbanistic models served as background of a great part of the Group's theories, wrote on this matter: "If it is produced an intimate relation between the environment and the behavior, the built area will be essential" (Nieuwenhuys 1959, 3).

Fig. 10 Herman Hertzberger. Photograph of the model for "Centraal Beheer" office building extension (6th of July 1978). Herman Hertzberger's archive

In contrast to the urban sphere to which the Situationist International applied the psycho-geography and the drift, Herman Hertzberger, in an unquestionable exercise of virtuosity, achieved to reduce the scope of these theories to his city-building, giving the freedom to decide on the environment where people spent most part of the day back to the user. The office building was constituted as a conscious whole of identical 'streets', 'crossroads' and 'towers' (as it is possible to appreciate in the Fig. 10), within which the only who was able to define a milestone was the worker who print its tastes and needs through the interpretation of the left space. Therefore, "Centraal Beheer" becomes an instrument whose interpretation had as main aim the emancipation and reaffirmation of the user.

The construction of "Centraal Beheer" and its inauguration in 1972 demonstrated that the realization of some of the postulates defended by Herman Hertzberger were not a mere utopia. The positive appraisal of the complex that was given by the most part of the workers and users, quickly placed "Centraal Beheer" as a paradigmatic example of a new architectural model focused on the enlargement of the human dimension (Hertzberger 2002).

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The Plan and the Score: The Analytic Drawing on the Elements of Architecture and Music

Antonio Armesto and Josep Llorca

Abstract Architecture and music are the two disciplines capable of delimiting a microcosm. This microcosm can be analyzed by its form and its style like the two directions of a fabric. The plan in architecture and the score in music can be both the representation of the form or the style and the task of the architect or the composer is to decide how elements can shape the form and which techniques can build the style.

Keywords Architecture · Music · Analysis

1 Two Precious Carpets: Architecture and Music

Approximately between 1856 and 1859, the German theorist Gottfried Semper (1803–1879) writes his "Theory on the formal beauty" in which he defines that "tectonics constitutes the pure universal or cosmic art. The Greek word cosmos (κόσμος), that doesn't find an equivalence in none of the alive languages, means both universal order and ornament." (Semper [1856–1859] 2014, 233). Semper mentions with this definition the double nature of tectonic: a discipline that is able to create an ordered universe by controlling the nature by means of the delimitation of the space—or the formal elements—, and simultaneously a discipline that is able to embellish this universe by means of the technical arts—or the style elements.

But this statement is three paragraphs away from a second one in which he defends that "tectonics, as a cosmic art, constitutes a triad with music and dance because, each of them in its field, they are not imitation arts. Nevertheless, the three of them, with their own and different tools of representation, proceed in a similar way when they conceive cosmically their specific task: how to give to the material

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its ideal expression. In the music, it also guides the law that conforms and embellishes, in other words, the ornament made clear and remarked, as harmony of elemental forces that work simultaneously." (Semper [1856–1859] 2014, 234). From this moment, Semper is not going to place architecture besides painting and sculpture, as one of the plastic arts (imitatives), but, with the name of tectonics, is going to became one of the "cosmic arts", by the side of music and dance. Architecture, music and dance are situated in a same level. (Semper [1856–1859] 2014, 23). However, the high ideal of tectonics is the static cosmos, and that of music, the dynamic cosmos; this clear distinction will force Semper to relegate dance to a different level and although he began his theory with the three arts, he ends by giving priority to architecture and music over dance. With this definition, Semper mentions again the double nature of music: a discipline that is able to create an ordered universe delimiting the wild nature that is around it by means of the delimitation of time and sound—or the formal elements—and simultaneously a discipline that is able to embellish this universe by means of the technical arts—or the style elements.

Therefore, a structural question is gathering us today: both of them conceive their specific task in a similar way: double but not contrary, bidirectional, like a fabric in which the two directions of threads are supporting each other and they are essential for the constitution of the carpet in which, "as it is known, the two threads that before of being weaved were equivalent, now they are not the same. Not because of their different material substance (wool, linen, silk), but because of the role they play in the constitution of the carpet: some of them play as warp (the longitudinal and parallel ones that you should tauten) and the others play as weft (in fact, there is only one, that goes and returns transversally between the threads of the warp, despite the fact you can cut it in order to change the colour, for instance, and then join the scraps for resuming the task) and other threads that they are not going to take place of the carpet but of the loom since fastened to the bars of the loom, they will be useful to separate those of the warp among them in order to the shuttle being able to weave with those of the weft. From the moment when the threads play a role in the loom, they are no more homogeneous and they belong to one of these three families." (Semper [1856–1859] 2014, 31).

The analogy that we are pointing out between the carpet and the two disciplines is a sameness of reasons, which would be expressed in this way: *the form elements are to the style elements* in the two disciplines *as*, in the loom, *the warp is to le weft*. In architecture and music we attend to the creation of the precious carpet that is constituted by form and style. Whereas, in the horizontal direction, the formal function system—the warp—looks after the basic elements out of the successive time on account of their condition of logical invariants (the hall, the enclosure, the roof, the note, the rhythm, the harmony) in the simultaneous order of the work, in the other direction, the structural phenomena system—the weft—has got the purpose of embodying these logical invariants till the point of turning them into concrete realities (colour, material, texture, timbre, dynamics). This begs the question: how does the man control the creation of this carpet? Which techniques does he makes use of for drawing the reality in a sheet of paper in order to control all the elements?

2 The Plan and the Score

On one hand, the architect has got the plan as the main tool. The plane, in its more general mean, as a representation of the tectonic reality that is going to be built. By means of the ground plan, the elevation or the section, the plan is a document that prints the three-dimensional reality in a two-dimensional mean making a translation of the object being represented. In fact, the plan collects every feature of the building and projects them on the paper, recording every form of the walls, the position of the windows, the colour of the surfaces, the position of the furniture or the drawing of the tiles on the floor (Fig. 1). Obviously, the plan is an exact tracing of the reality and it doesn't permit of doubts about how it is going to be the building, what is more, there is the building. If we turn our sight to the definition of architecture as cosmic art made by Semper, we can distinguish in the plan the two axes of architecture—form and style—superimposed, because we find in a simultaneous way the form of architecture and its colour, texture, and material features.

By the other hand, the composer has got the score as the main tool. All over again, the score is understood as the representation of the acoustic reality that is going to be performed. The score is a document that prints the sonorous reality in a two-dimensional media by making a translation of the image of the object being represented. In fact, the score picks up every feature that constitutes the work and

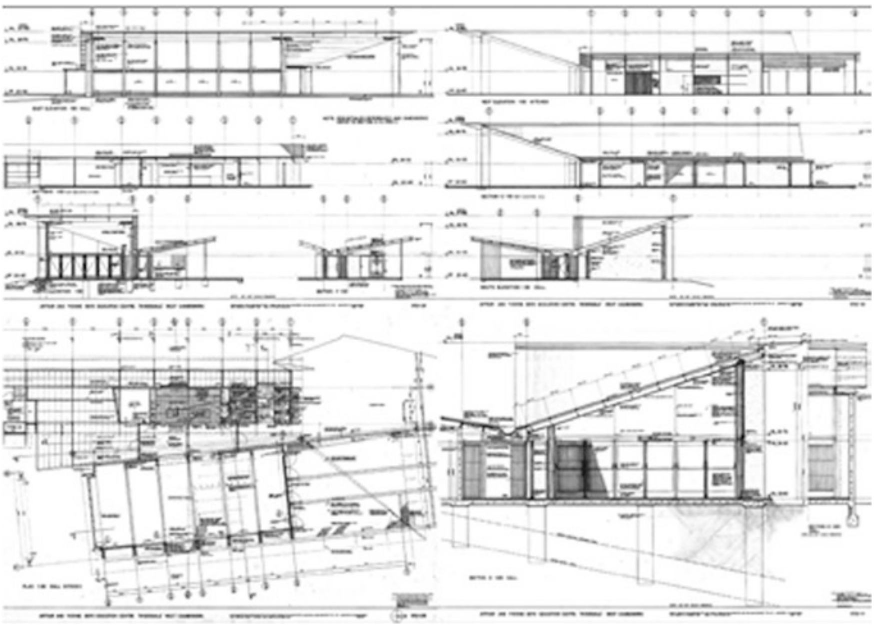

Fig. 1 Plan of the footprints and sections of the Education Centre Riversdale of Glenn Murcutt. *Source* El Croquis "Glenn Murcutt" n. 163–164. Note the great quantity of information contained in the sheet of paper

projects them to the paper, recording every note of instruments, main and secondary melodies, harmonies among voices, dynamics, timbres or the work's form (Fig. 2). Music as cosmic art is printed in the score when formal functions and its structural phenomena[1]—form and style—are weaved.

3 The Representation of the Warp or the Strictness of Form

The first of the features, and maybe the most important, expressed by the plan and the score is form, because form possesses an atemporal character. We understand form as the contrary of material: if material is what things are made of, form is what determines material in order things are what they actually are. Italo Calvino, in his "Invisible cities", says by Marco Polo the following aphorism: "The bridge isn't held by this or that stone, but by the arch's line that they are forming". Therefore, if there is something that should inspire where things must be put, this is form. Accordingly, form is more similar to geometry than to construction. As a result, form analysis is understood, under this conception, in a more logical than phenomenological way.

This logical knowledge of the discipline points out the formal aspect, the *warp* of the carpet, understood as an insight of the internal structure of the work. Hence, we are interested in finding an analytical system of form representation in architecture that, starting from the basic features of the elements, could end in a symbolic notation and a tool for the project. In the research of this system we find other composition disciplines that count on a symbolic notation; the epitome is music, in which this notation system allows the composer writing music without the necessity of attending to the physic dimension attached to the acoustic phenomenon neither, the musical instruments or the interpretation. Conversely, we find in architecture the following paradox: he possesses a formal nature but, as a discipline, is very low formalized because it doesn't hold symbolic notation system in order to generate works in a deductive way and with a high control of its internal structure.

A representation system based only on form divests the work of every particular feature that attach it to the technique of the moment (constructive system or timbre),

[1]Formal functions attend to the role played by each of the parts in the musical work. They constitute its form. In this context, there are the introductory function, the expositive, elaborative, transitive and conclusive in a big scale and the period, the phrase, the motive or the cell in successive lower scales. On the other hand, the structural phenomena embody these functions in concepts that we can get by sense such as timbre, dynamics, agogics, texture, or modulation. The changes in structural phenomena reveal the change from a function to another function. In this way, the two dimensions of music—the warp and the weft—are intimately related.

Fig. 2 First page of the 2nd Mahler symphony, "Resurrection". Note the great quantity of information contained in the sheet of paper. *Source* Universal Edition A. G.

to the life (the architectural program or the lyrical program), and to the place (the topography or the thematic material). Geometry in architecture and harmony in music are what remain. They are few examples of representation at this level. But they hold the essential force of the elements represented in its nakedness.

A good example is offered by the Greek musician and architect Iannis Xenakis. In his years of work with Le Corbusier he composed his orchestral work *Meastaseis* (Fig. 3). Metastaseis begins with a G played by the 46 strings by unison, pianissimo. It is G2, continuous and apparently eternal, immortal. After that, above all the first of the first glissandi rises up. Before of the entry of the viola it will have sounded a dry knock in the woods. And in this moment the incorporation of the other 43 string instruments into the glissandi takes place till opening the register in a huge 46 note chord: the seven pitches of the C major scale played at the same time and in different octaves. The high pitches have moved upwards and the lower ones downwards opening the fan and holding the chord during some seconds (Llorca et al. 2012). The author gets the inverse effect at the end of the work, in which a big volume of 55 strings deployed uniformly is going to fold over itself sliding from some notes to others without brusque changes, but searching by means of glisandi the continuity in the acoustic result. This effect is revealed in the graphic score made for the study of the voice directions. The result is a net that points out only the pitch of the sounds and the continuous rhythm that they follow: The horizontal axis represents the time and the vertical represents the pitches of sounds; there is nothing more represented here: nor the timbre, nor the dynamics, nor the expression. Xenakis made an analogous procedure in the plans for his *politopes*, ephemeral buildings made of tense wires and under canvas. In particular, that of Montreal (Fig. 4), where he only represented the ruled surface of the walls without any reference to materials and colours.

But Xenakis' example is situated in a place where the particularities of the work are relevant and it is not abstracted to the formal scheme, because, in the case of *Metastaseis*, the representation is attending to the particularity of each voice without clarifying that the whole work maintains a ternary form of the same nature as a sonata form; and, in the case of the *Montreal Politope*, the particular features of the ruled surfaces hide the fact that the work is a closed space, like any other hall. This kind of representations are still so much similar to the plane and to the score.

The analytical notation introduced by Lerdhal and Jackendoff en their “Generative theory of the tonal music” is nearer to what we are searching for in the music (Fig. 5). Here, they don't pay attention to the timbre, dynamics or even notes, but they show only the tension-resolution aspect of music, that corresponds directly to the formal aspect. Their tree schemes connect each unit (notes, cells, motives, phrases, periods, sections) with superior levels in a way that the whole work is branched in more concrete parts. A similar notation in architecture would help us to understand it as a closed work, and we are not convinced at all of the benefit of this point of view.

But if we want to find a symbolic notation that expresses only form we must fall back to the scheme. In architecture this must be translated in a simple drawing containing the elements in an analytical way, that is, being independent among them and at the same time, as a joint. For this purpose we have begun an attempt of drawing of these elements and their possible combinations in a kind of an Architecture Periodic Table (Fig. 6). Here we can see in the horizontal axis the three basic elements from the others are combined and formed and, in the vertical

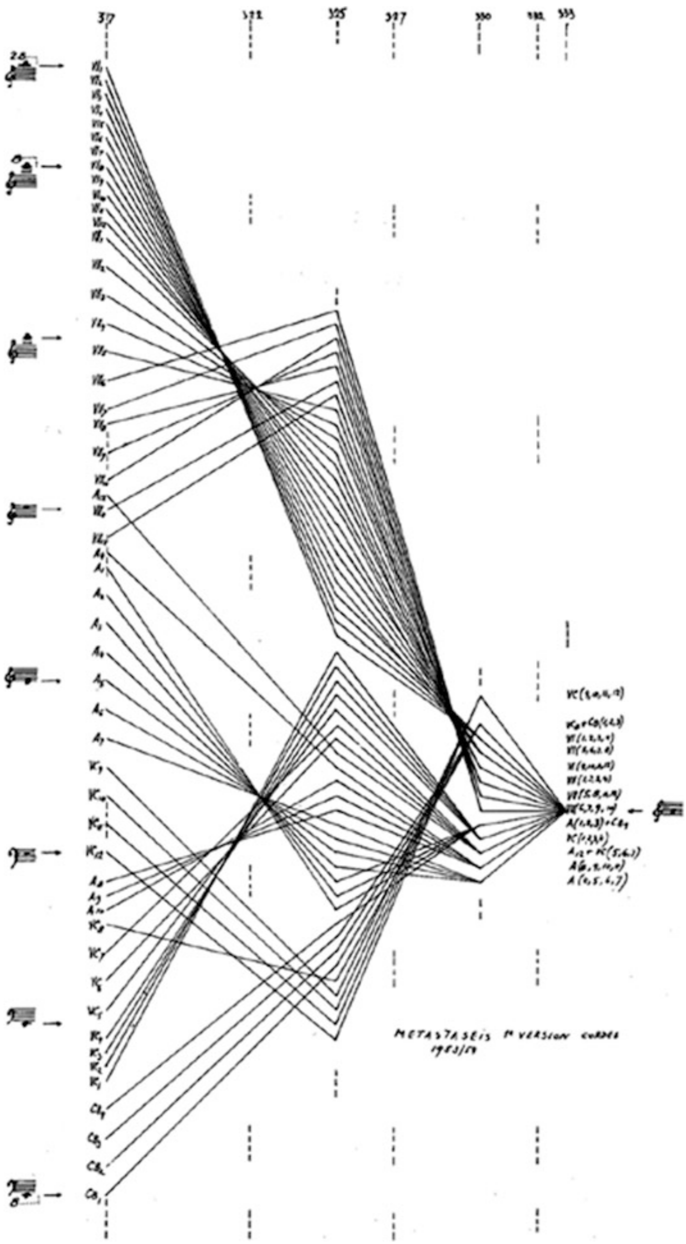

Fig. 3 Graphic score of the last 16 measures of Iannis Xenakis "Metastaseis". There are only represented the pitches in time, without reference to timbre and dynamics

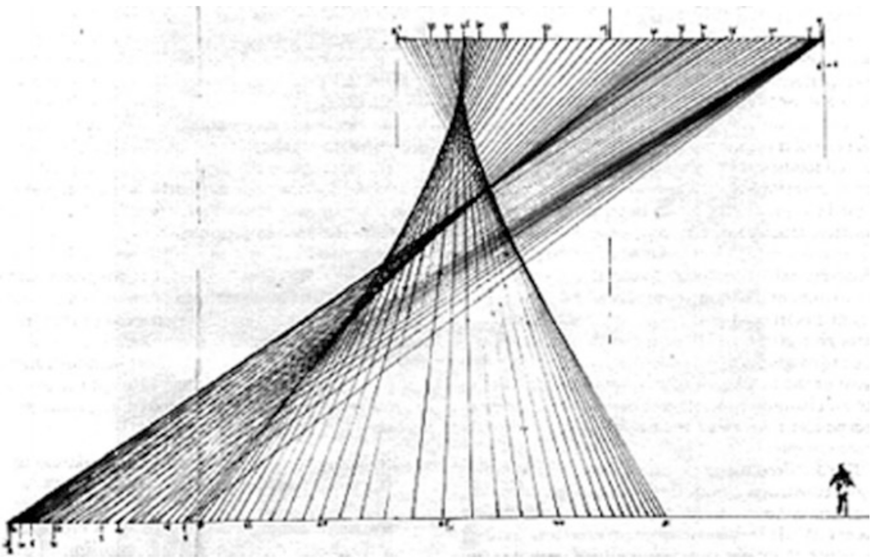

Fig. 4 *Montreal Politope* elevation, Iannis Xenakis ephemeral pavilion. They are only represented the lines that constitute the ruled surface, without any reference to material and colour. That it is going to be built

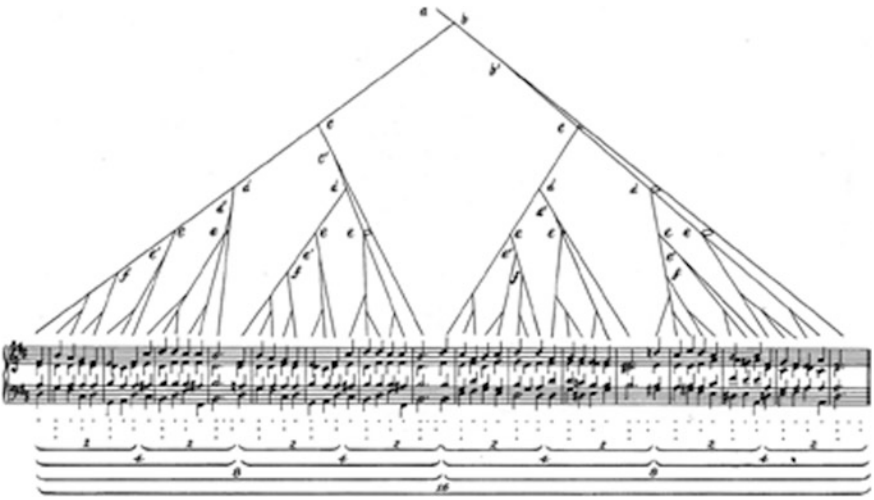

Fig. 5 Formal structure representation of the Johann Sebastian Bach *O Haupt* choral made by Lerdahl and Jackendoff. The tree scheme shows the more important events over those that are not so significant and it clarifies the structure of the work

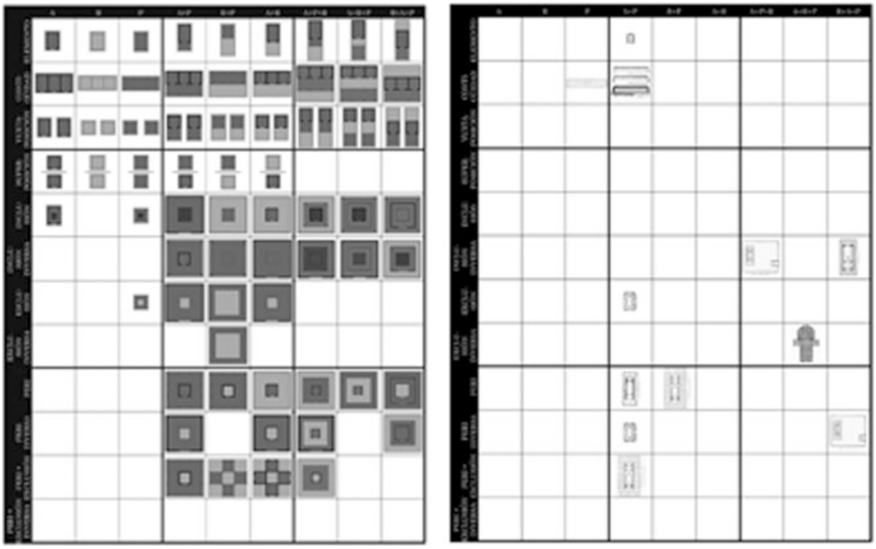

Fig. 6 Architecture Periodic Table with its examples table. Authors' work

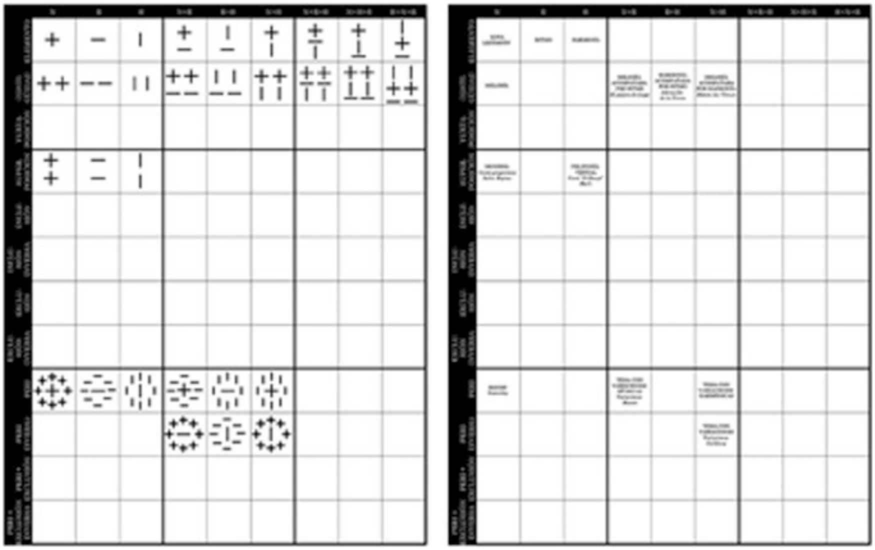

Fig. 7 Music Periodic Table with its examples table. Authors' work

axis, the formal operations that affect on these elements. The same way round in music when we want to explain it formally: we must resort to a scheme containing all the elements in an analytical way able to be combined. For this purpose we have begun, again, a Music Periodic Table (Fig. 7).

The first task when we make the Tables is to define the basic elements of each discipline. In both cases there are three elements. In architecture: the *enclosure*, combined with the *roof* gives rise to the *hall*. In music: the *rhythm*, combined with the *sound* gives rise to the *note*. Our aim is not to demonstrate the parallelism among the terms of one and another discipline, but the existence of a structural analogy. Both of them work in a similar way but each one from a specific place. For this reason, *hall* and *note* are the primary elements of both Tables and they are put in the first place from which the others can be developed. Architecture and music are shown to us as syntactic games, as *ars combinatoria* in which the different elements of the Table find their place on the wide world and on the length history. These Tables are very useful in order to distinguish the nature of each of the architecture and music forms and, as a gift, to take account that there are some formal schemes that are similar in both disciplines, proving Semper's hypothesis.

As some examples we leave the following: we check that the forum (an enclosure that contains a four-sided portico in its interior) is the logical inverse of the periptero hyphaetros temple (an enclosure with a open-air hall rounded by a four-sided portico); similarly, in the music field, we can observe that a rondo (a main theme surrounded by secondary themes: ABACADA), is the logical inverse of the simple ternary form (a principal theme that surrounds the secondary theme: ABA).

4 The Representation of the Weft or the Splendour of Style

Plan and score are able to express the other dimension of the carpet, the *weft*, the vertical axis. This axis, as Jakobson mentions, selects one specific way of representation of the formal elements in concrete realities (Jakobson [1967] 1980). This means that, in architecture, the element called enclosure—yet a logical creature—that goes before Aalto's Muuratsalo house is made of bricks in spite of concrete, stone or a hanged carpet. In this moment, the most important thing is how is it made, which is its appearance to our senses. In music, it happens something similar when Debussy begins his *Prelude a l'apres-midi d'un faune* with a chromatic descendent scale—that is, an abstract element—with a flute timbre filling the whole hall with a gloomy atmosphere that is distinguished all over the work.

The plan is, again, in charge of representing the style in its splendour. It pictures the colours of the windows, the details of the work, the textures of the walls, the tilling of the floor, the shadows of the exteriors, the curtains that will cover the windows, the light illuminating the interiors, the cold steel where is going to catch the fire, the warm wood of the rail, the reflecting water in the patio, the creak of the wood under the grandfather's feet, the chirping of the door hinge… A great world of details that embodies architecture. The plane is in charge of indicating it in order to be built (Fig. 8).

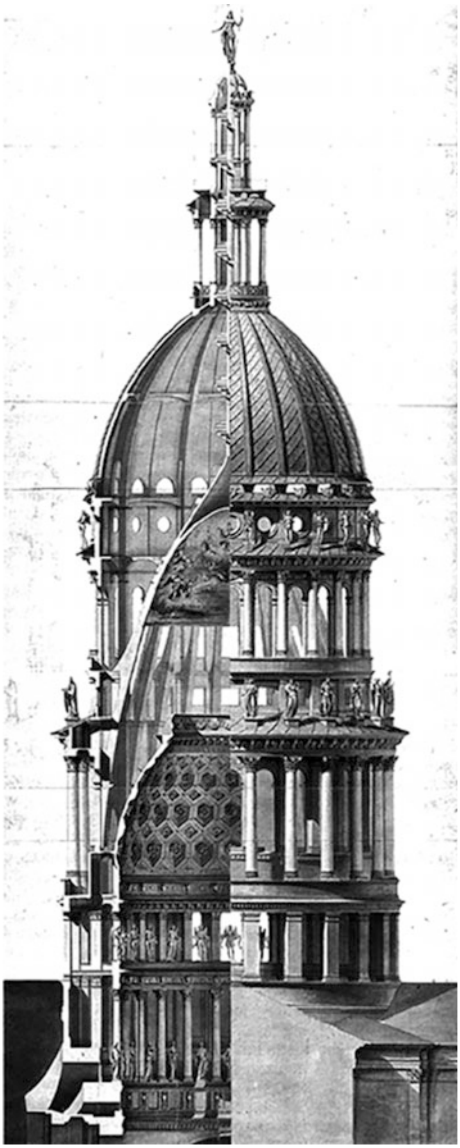

Fig. 8 Alessandro Anonelli's drawing of the San Gaudienzio's dome. The details of the frescos, the structure and the light through the openings describe the reality of the building

The score is, as well, in charge of representing the style in all its splendour. It indicates the first silence, the violins pianissimo, the trombones sforzando with the main theme, the distance of the horn that is finishing the leitmotiv, the overwhelming sudden piano, the counterpoint between the oboe and the violoncello that flows into a crescendo, the choir voices retaking the main theme over a carpet played by the woods, the contra subject that emerges from the double basses, the

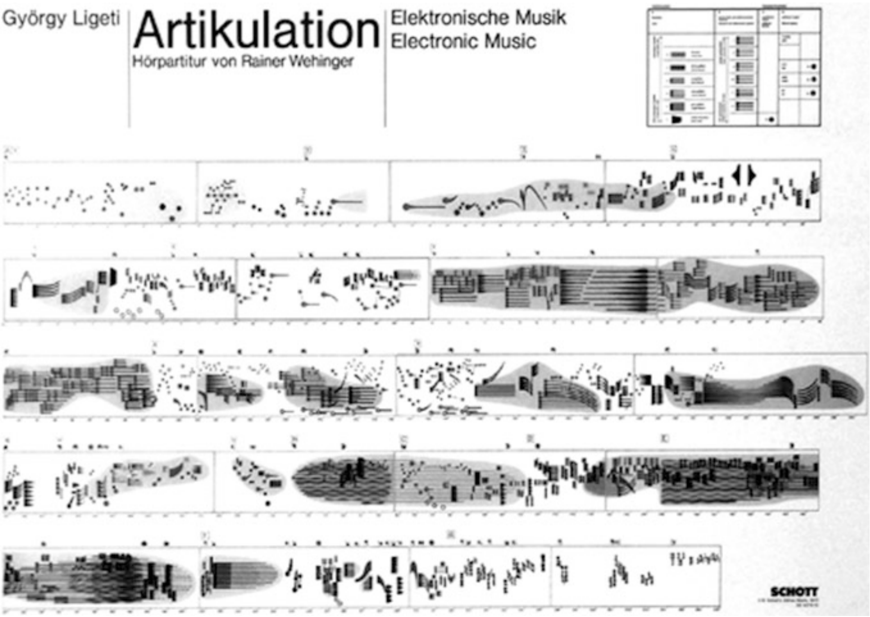

Fig. 9 Score of Györg Ligeti's "Artikulation". The graphic symbols, with its forms, its colours and its positions indicate musical values of form and style

uninterrupted rattle of the Chinese box that dominates the orchestral volume, the held breathing of the white voices exhausting the last sight of the work… A great world of details that embodies the music. The score is in charge of indicating it in order to be interpreted (Fig. 9).

5 Ending

After having distinguished both values offered by a plane and a score our aim, finally, is to point out that architect and composer's task doesn't consist on treat favourably one instead of the other but, in the architect's case he uses initial sketches and schemes in order to puzzle out the form and, at the same time, he draws details that persuade him to a style: everything is offered to the author in a synchronic way, not synthetic, in a way that the work is formed as a totality. In a similar way Mozart described composition in a 1789 letter: "All this fires my soul, and provided I am not disturbed, my subject enlarges itself, becomes methodised and defined, and the whole, though it be long, stands almost finished and complete in my mind, so that I can survey it like a fine picture or a beautiful statue at a glance. Nor do I hear in my imagination the parts successively, but I hear them as it were, all at once… What a delight this is I cannot tell!" (Holmes 1854, 329).

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Research Over a Brazil: Travel Impressions of Lucio Costa

Gabriela Farsoni Villa and Joubert José Lancha

Abstract Training trips are understood as a moment of analysis and reassessment of references traveller. In this sense, the trip is understood as a movement through time, space, where art becomes a mediation of the experience of traveling as knowledge process. In his trips, Lucio investigates and he's in contact with Minas and Portugal, with the roots and contamination between the Brazilian colonial architecture and the Portuguese and what are their specificities and authenticity. The theme throughout his trips is the same, even in his trip abroad, the object he is looking for is a Brazil's theme.

Keywords Trips · Lucio Costa · Drawing

1 Travel

The principle of human migrations in history was marked by nomadism, model in which people were intended to move to more appropriate and safe territories to live. As an example, the Great Navigations in the fifteenth and sixteenth centuries, seen as exploratory expeditions sought to conquer new colonies in America, Asia or Africa. Some of them have had no return trip format, being fixed in the "new world". We understand these trips as a reference of that format transformation. The Renaissance invented new observers with a more scientific look. The travelers have been transformed and so the intentions and motivations of travel had, due to the itineraries looks and records changes.

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To the ancients, the trip was a heroic journey but today it is an option. As defined by Pimentel (2001): "… product of free choice, opportunity to demonstrate an identity, look for freedom, self-display or self-knowledge …".

"Traveling" and "power" could mean the acquisition and possession of means, whether material or intellectual, allowing the uprooting of the subject at the same time that it let the subject perceive new places. Due to this pretext we comprehend travel in the architecture scope, from the idea that going away from a comfortable ground to the unknown direction, looking for belong to another space.

The act of traveling, as the world knowledge practice, contemplates own structures, which can also be studied through the stories left by those who traveled or by itineraries, cartography, notes, correspondences and drawings.

The act of traveling is above all an act of reading, and that kind of reading is mostly non-verbal reading. Discussing the peculiarities of non-verbal reading which means space, there is the inability to read what is homogeneous, indistinct. "For that reading to be done it is necessary to make the spaces heterogeneous through an operation of the mind capable of causing a value, a predicate, a judgment that attracts our attention to specific space fragments and impose our perception, which means to project an image of the environment as a whole and act as an extension, an index of it." (Ferrara 2009, 23).

Engel (2009) defends that the most frequent way for the learning approach takes the concept of differentiation, which refers to the subject's ability to perceive differences in the phenomena. So that "the direction of learning is therefore the increase of assignable sensitive layers, resulting in a kind of thick gain realized by the World." (Engel 2009). Distinction between samples with contrasts increasingly tenuous, what we call perceptual competence.

This spoken distinction is largely constructed by the subject's repertoire that is both personal and cultural.

It is as if the intention of the trip taken to a certain address, along with prior knowledge of the traveler, their baggage, will allow them to articulate readings, read what is not only hidden, but that place can be built through reading. Engel (2009) tells us about the concept of articulation: "Finally, the last proposal clue to consider learning the production of a sensitive body concerns the role of the articulations. Articulate, in this case, means establishing alliances, connect different percepts together or connect them to elements that belong to different universes. It is about finding new points of contact, approaches that do emerge striking features of the environment or the perceived object".

In the architecture travels, physical contact with the space, the object of study is important to be possible a full perceptual experience possible, here is phenomenological, as pointed out by Merleau-Ponty. Phenomenon that is captured by the traveler, confronted and later recorded, transformed into reasoning. then differentiating these two moments, the end is only possible through the mediation of the first, and you can only produce it, the record, after you understand the object that is seen. This will be possible therefore due to the experience and not the reasoning. For those trips where the architecture and the space is the opportune matter, the understanding of what it has been seeing enables the drawing, just draw what we perceive so the drawing itself enhances and enables the reasoning.

> The time of the look who draws is special, reveals the desire to ownership thing seen by the hand, to keep in memory the gesture turned into a trace, the memory space. (Araujo 2013, 271).

We will go through Lucio Costa's travels, since his incursion into the interior of Brazil to his travels to Portugal in this sequence, with some nuances that I will mention below.

2 Lucio Costa

Lucio Costa, architect graduated in (ENBA) Escola Nacional de Belas Artes in Rio de Janeiro in 1924, have taken his first architecture trip even as a student to Minas Gerais which was sponsored by José Mariano Filho, in order to gather documents, registering a set of elements that defined the *neocolonial*.

The beginning of his career was marked not only by the influence of the ENBA in his studies, as well as the eclectic architecture dominance in that period, he was also one of the most prestigious architects within the neocolonial movement, marking a distinct stage in his theoretical and architectural production.

From 1924, on his famous trip to Diamantina was when the architecture student came into contact with the city's colonial period, the purity and simplicity of the hidden civil architecture within the country.

A break with the neo-colonial movement which he participated would happen later, after researches, trips, confrontations and reflections on old Brazilian architecture, the Portuguese and the modern.

The promotion of emerging Brazilian modern architecture is related to professional practice and education, especially because of the episode in 1930 which had the teaching methods reformed in the ENBA and the project for the MESP (Ministry of Education and Health) to Rio de Janeiro in 1936, with the collaboration of the young Oscar Niemeyer and clear influence of Le Corbusier.

Another important moment of professional practice and politics of Lucio Costa was in 1937 in when he joined to SPHAN (Serviço do Patrimônio Histórico e Artístico Nacional), where he stayed until 1972. It was during this period that the notions of modernity and tradition are confronted in Lucio actions, where trips to Portugal are inserted both the one in 1948 and in 1952. These notions were certainly mediated by the experiences of the trips.

3 The Research

The research conducted by Lucio during these trips, both the Brazilian and the Portuguese had been done around the Brazilian theme, under the precept that the Brazilian ancient architecture lacked a convenient and depth study until now unfulfilled.

This research looking for a national understanding, was the one which would base modernity to Lucio Costa, it was not his exclusively practice, based on the Brazilian cultural context in 1920, where modernism as a project fomented a peculiar climate, to encourage the research for a Brazilianness authentic, other theorists and artists have taken similar trips, often to the same destinations, and Minas Gerais stands out as itinerary. The set of these trips, each one with its own approach, played a key role in building a modern imaginary, kept the intention to the country recognition, the roots affirmation. There was a current that interpreted the colonial architecture in an evolutionary approach where the final expression would be the modern architecture.

The trips can be understood as intention, project, and at the same time, meeting. There is an apparent transition between trips addressed to Minas Gerais and its subsequent to Portugal, the transition is also visible by differences expressed in the drawings. The drawings produced in Brazilian trips are more technical, with heritage survey character, cataloging, different from the material left by the Portuguese trips, where the sketches appear stronger and free (Figs. 1 and 2).

Lucio Costa travels to Portugal, looking for the architecture of this country to better understand the Brazilian one, with a concern quite anchored in the present, but aware about the need to look back the past. “He went to the stone quarry to better understand the stone, or rather, he went to the stone quarry as seen from the

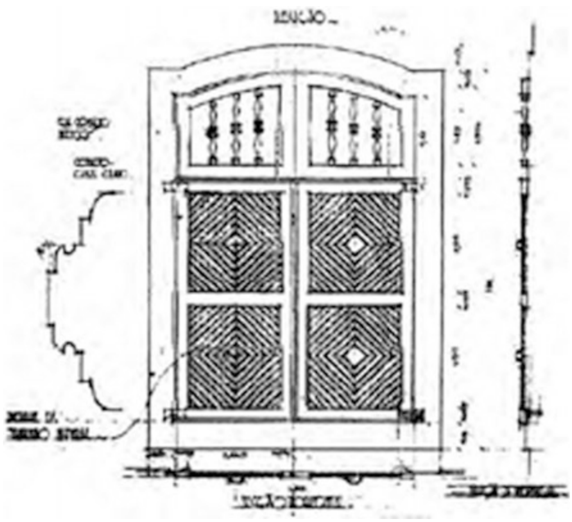

Fig. 1 Truss drawing, Trip to Diamantina. 1924. *Source* Collection Casa Lucio Costa

Fig. 2 Watercolor "Passadiço da Glória", trip to Diamantina. 1924. *Source* Collection Casa Lucio Costa

stone's point of view" (Araujo 2013, 267). To Lucio the relationship between the Brazilian and the Portuguese architecture was not a simple model scheme and copy, but the confirmation of both authenticity. It is not a dependent artistic relationship but the existence of a common vocabulary that was developed in different countries each of them maintaining autonomy. It was common at that time to emphasize more strongly the aspect of continuity and not of autonomy, and Lucio Costa, thinking within the modern movement, thought it was more important to note the differences. Lucio Costa then defining his peculiar notion of modernity sees no opposition between the concepts of continuity and autonomy, but a familiarity. Considering that, Lucio denied the identity appeal promoted by the neocolonial movement, bringing to his architecture, a new way of being modern and traditional at the same time.

The displacements that the architect have done highlighted the importance he gave to the place experience, the time and the shapes experiences, as an essential possibility of learning in architecture.

4 Portugal: 1st Trip, 1948

The motivation of this first trip to Portugal, taken between 1948 and 1949, was in line with the concepts of modernity that Lucio was formulating, beyond the belief in the formulated hypothesis that in the Portuguese civil architecture would be the matrix of Brazilian colonial architecture. It was an attempt to establish, from the on-site observation, the influence the Portuguese architecture have had on the Brazilian colonial one (Fig. 3).

This trip was been taken in the company of his wife and two daughters, and was characterized as a trip marked by official commitments and strong production of texts, which was Lucio's responsibility due to his important services to the SPHAN. It was also a journey that, in addition to Portugal, included other destinations, either by a desire to get to know, to verify or to formulate ideas about the research in

Fig. 3 Lucio Costa's first trip folders. 1948. *Source* Photography José Pessoa

historical heritage, such as the passage by Germany in order to get to know the Baroque religious expression in the country, considered by some historians to be similar to the expression of that art in Minas Gerais, again the concern to draw parallels with the art and the Brazilian architecture.

It was a verification trip, but not the same verification which it was possible the perception of nuances between Brazil and Portugal, as would happen in 1952, some anxiety in proving a theory animated him, which was not possible, as he himself noted as a failure in a document entitled "Introduction to a report," published 40 years later in his autobiography, "Registro de uma vivência".

This first trip provides to Lucio, however, the understanding that the relationship between the architectures developed in both countries were not the result of a simple equation, membership, and opens the way and the need for further study trips.

As record of this period traveling, Lucio does not bring drawings, but a collection of touristic folders from the cities he visited.

5 Portugal: 2nd Trip, 1952

The unresolved questions from the previous trip and the desire to understand them in addition to look for a treatment to a health problem in the family, led Lucio Costa back to Portugal in 1952. The second trip to Portugal has a solitary character and it is seen as a "service". Lucio crosses the country through all its different regions, and does so with a particular attention to art and Portuguese architecture that would have some proximity to what have been developed in Brazil.

This itinerary offers a distinct understanding about the relationship between art and Brazilian and Portuguese architecture, and their own ideas about modernity and tradition in relation to the result of the first trip, and also in relation to the trips to Brazil, all of them have been taken with the same thematic concern, however, the latter with a different focus, the authenticity of each production.

From this trip, have been later accessed a set of five small sketchebooks, all of them filled with observation drawings, notebooks that have been objects of exhibitions, researches and studies in history and representation and language areas.

5.1 The 5 Sketchbooks

The tonic of the sketches has its sense given by Lucio's description as schematic notes. The drawings had no intention of presentation, but dialogue, extension of thought, and why not extension of the place, as a new built reading. The drawings in the small sketchebooks have the characteristics of notes, they are spelled observations. These considerations are taken on how the drawing is presented to us, the mix of representative resources such as schematic plans, facades, perspectives, details and texts (Fig. 4).

So that is how visible Lucio Costa interest on the set and on the constructive and decorative elements, accordingly is visible.

Commenting about the importance of registration: drawing the time as a result from this method: "In the drawing, the feature requires the choice of an X number of elements and synthesizes the image through them, unlike photography, where even when shooting a detail it brings a loaded image elements. Those drawings in particular are ultra synthetic, few traces, few gestures" (Araujo 2013, 271).

The drawing would make the space transportable, again mentioning the trip stories, memories, which is always possible to return, and they always retain a power to remind the place, the experiences, reflection, in the return direction. The drawing process then gives more space to thinking about the place logic, it is a complementary activity to the trip.

Fig. 4 Sketchbooks of Portugal. 1952. *Source* Photography José Pessoa

5.2 The Swiss Sketchbook

First sketchebook of the series, characterized by dense pages. The drawings are almost superimposed on the sheet. This sketchebook contains most of the buildings icons and religious drawings. Mantains a link with the heritage drawings that were made on trips to the interior of Brazil, with a clear difference in the trace, which tells us about a movement, a production time already very different.

5.3 The Red Sketchbook

In this sketchebook, it is evident the attention and the record of the popular Portuguese architecture. It is observed some concern with the elements, but without the recurrence of the separation procedure that is strong in the posterior sketchebook (Figs. 5, 6 and 7).

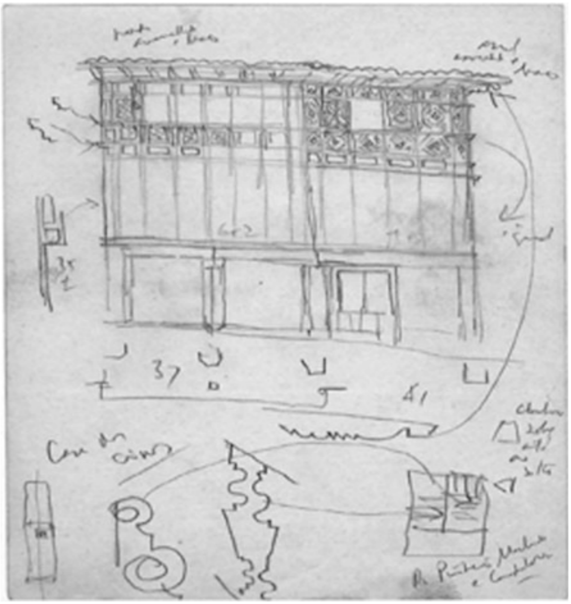

Fig. 5 Sketch of Braga, Casa dos crivos. 1952. *Source* Photography José Pessoa

Fig. 6 *Top corner* Póvoa do Mileu, Guarda. Notes and sketches in Venda da Serra, Mucela Bridge. 1952. *Source* Photography José Pessoa

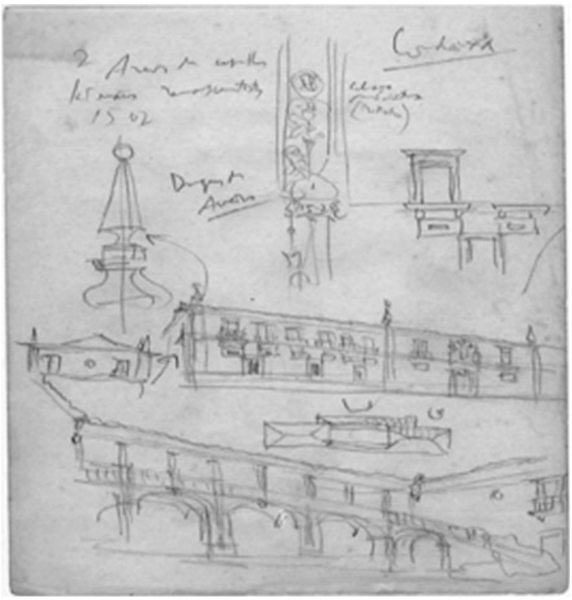

Fig. 7 Sketch of Condeixa, Conimbriga, Agueda and Mealhada. *Top* details of the remaining ruins. *Middle* Palace of Figueredos. *Down* Talha joanina do arco cruzeiro. 1952. *Source* Photography José Pessoa

5.4 The Ocher Sketchbook

One of the most striking features of this set is the obsessive investigation to find the identification of the elements in the drawn buildings, often containing an overview and many details cut down from this view, then enlarged and drawn from various angles. This elements identification procedure will allow Lucio isolate both on paper and in thought and compare it with the architectural structures made in Brazil.

5.5 The Brown Sketchbook

It is marked by the drawings of rural architecture of the region, “altejanos mountains”.

5.6 The Blue Sketchbook

Contains drawings related to the trip taken between the 1952 and 1953 winter, traveling back to Portugal, one of the aspects that marked this trip was leaving the car in the traveled paths, so the distances on foot in the cities marked another time, in speed and incompleteness of sketches. It is only during this period that the capital Lisbon drawings appears and with them more free ones, with higher incidence of urban scenes and everyday themes drawings (Fig. 8).

Fig. 8 *Top* Sketch of the order 3rd hospital. *Down* Lisbon urban life. 1952. *Source* Photography José Pessoa

6 Final Comments

We can be affected by the false idea that the trips Lucio Costa have taken were only by interest in heritage studies, that would stuck him in the past. But his incursions in the past show us the most, reveal the concerns he had with the present and especially with the future of the Brazilian architecture. “If it is absolutely necessary to go back to the past to realize identity links, the record can not be done if it it want to stay there.” (Araujo 2013, 264). The records and notes as a mean or a format, maintaina link with the need to get to know the place and the possibility of return, of afterthought, which is the trip notebook characteristic. The impressions recorded in the sketchebooks point every time to this present belonging relationship he had and to be able to get some knowledge about it, as well as proposals for the future.

Note

1. The book “Portugal’s small sketchebooks. Brazilian architecture in Lucio Costa’s trace” (Pessoa 2013) is the result of a work in group organized by the architect José Pessoa and Maria Elisa Costa, architect and Lucio Costa’s daughter due to the discovery of those five sketchebooks, after 50 years of its development in the Portuguese trips. An exhibition with these drawings, which was on display in Lisbon and Rio de Janeiro happened in 2012, curated by José Pessoa.

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The Study of Architectural Heritage with HBIM Methodology. A Medieval Case Study

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Abstract The communication deals with the first results achieved in the development of the research project entitled: *the Design of a Database, Management Model for the Information and Knowledge of Architectural Heritage*; HAR2013-41614-R, subsidized by the Spanish Ministry of Economy and Competitiveness through the National Programme for Research Aimed at the Challenges of Society. The objective of the exposed issue is to elucidate the necessity to define a method to generate a database with the Building Information Modeling (BIM) methodology for medieval heritage architecture's management through a virtual model, which binds the whole of the information. The communication exposes the process of three-dimensional modelling that is necessary to host the BIM database. This way, the previous studies allow to understand the overlapping episodes, enlargement/reform, and to read, in the monument's walls, the footprints that different civilizations have left over time. Likewise, this concept was added to the virtual 4D model as the historical construction phases. The first results show the process of inserting the point cloud in BIM, the design of a specific historic template, the generic modelling, the specific modelling of objects—both existing and disappeared ones—the creation of BIM families, the generation of medieval materials, and the representation of the archaeological remains. On the other hand, the representation of the historic and constructive evolution, with all its data embedded in one single model, has produced very good results in order to interpret the evolution through the heritage virtual model. Thanks to the specific Historic Building Information Modeling (HBIM) methodology, it was possible to unify the information that was spread out around the heritage projects and make comparisons with other methods.

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1 Introduction. Objectives

This communication shows the part of the research project entitled: *The design of a database, a model for the management of information and knowledge of architectural heritage*; (HAR2013-41614-R). This work corresponds to the three-dimensional modelling process of a monument applying the BIM edge technology. Therefore, it deals with the three-dimensional architectural survey of the building and the cognitive process around the monument, typical of the Architectural Graphic Expression field.

These processes, in buildings with heritage interest, require special attention, and thus, the following questions emerged: Is it reasonable to conceive the study of an historical building without contemplating the whole of the aspects which have accompanied it along its lifespan? Can we be able to resolve the issue through the implementation of the BIM technology given the success it has experienced in the industry and in new buildings? Can BIM be applied to the study and management of medieval architecture? The search for answers is the basis for the setting of objectives in this part of the research: The main objective is the description of the modelling process in the BIM for historical buildings. The intermediate objectives are: to make an architectural survey with a laser scanner, to generate the general geometrical modelling, to complete with the specifi modelling, to represent the archaeology in three dimensions, and to create standardized families—basic units in BIM—of the most signifi mediaeval elements.

The proposal is to document the historical building, both through the laser scanning as well as through traditional methods. Historic monuments have an extended evolution that usually has altered some of its features: repurpose of structures, reuse of materials, and shape variations caused by crashes and different lesions. Because of that, it is recommended to collect data with high precision. Currently, the scan products—such as the 3D point clouds with an infinity of geo-referenced points—have become one of the main sources of information perfecting the traditional survey. The three-dimensional model, which is composed by a geometrical set of millions of points, provides an accurate record of the building morphology. And it is an indispensable support for preservation, restoration, and for the development of the heritage patrimony (EHM and Hesse 2014). However, the mechanization of the data collection leads to a less deep cognitive knowledge process of the monument than the traditional survey data collection, even if with good graphic result. Quoting Renzo Piano's words "think and do," "draw and do," it is claimed that graphic expression is the main tool of architecture. Therefore, the point cloud is set out as the origin for the historical BIM modelling since the geometric constructive modelling is needed for the analytical, projective, and constructive understanding, as well as to get a deep understanding of the building genesis (Mondragón Solis et al. 2015).

The simple treatment of the point or the application of texture and photographs over the point's clouds is insufficient in order to get a deep knowledge of the monument. To achieve a deeper knowledge, there is a need for the graphical analysis and the three-dimensional modelling, as part of the hermeneutic process of the building. This justifies the use of BIM, because with this methodology we build instead of draw. The modelling process, starting from point clouds and including the study of its information, requires a methodology to take advantage of all these data. This methodology, under the concept of "Scan to BIM", has been defined by scientific texts that address the best way to move scanner laser data into the BIM model (Mahdjoubi et al. 2013).

Using the BIM method to model means the reunion with the essence of the cognitive process about the building, both in the early stages of the project as well as throughout its evolution in time. The Graphical Expression facilitates the availability of information to the rest of fields with a feedback process as to know how the monument was generated, as well as how it was managed and developed during its lifespan (Holmström et al. 2015).

Based on these assumptions, it is necessary to recognize the most optimal modelling style to generate a three-dimensional model that can accommodate an attached database. Four architectural survey systems coexist in essence: traditional method, topographical method, photogrammetry, and laser scanning (Artano et al. 1998). Currently, the most used three-dimensional heritage graphic systems are essentially two: surface meshes models, and solid geometric models. Being the latter one used in BIM methodology. This modelling system is characterized by building virtually using the classical geometry as a base.

After the appropriate analysis and experimentation, the BIM modelling methodology was considered the most suitable because it synchronizes the information in real time and the large internal storage capacity of the system. In addition, this method has achieved very good results for new buildings, sustainable architecture (Inyim et al. 2015), facilities, and structures. Thus, it arises the opportunity for its adaptation to Architectural Heritage. In this area, Dore and Murphy have defined HBIM as the way to model and manage historic buildings with BIM (Dore and Murphy Dore and Murphy 2012). Nevertheless its practical implementation is scarce, being almost in a theoretical framework level (Volk et al. 2014). Likewise, its geographical extension is concentrated in England in terms of projects management, and in Italy just for architectural survey (Garagnani 2012), not so much on construction and management, which are the final aim of this research.

The case study selected to be the experimentation laboratory for the medieval architectural heritage, was the South Courtyard of San Juan del Hospital of Valencia (Garcia and Lopez 2014) because it meets the necessary characteristics to develop the HBIM technology. It was declared Historic Artistic Monument at National Level by decree on April 5, 1943 (BOE 16.04.1943) and the entire complex was configured as "San Juan del Hospital Museum" in February 1997 (B.O.E. of 16 April 1997). The South Courtyard of San Juan del Hospital of Valencia was chosen as pilot case since it gathers a set of characteristics and circumstances that make it ideal: it is a medieval historical building with complexity regarding constructive phases, it has a wealth of information that allows the site's knowledge, and it belongs to the Mediterranean Gothic typology of architecture, which has standardized elements.

2 Methodology of the Modelling Process

Synchronization is the main characteristic of BIM. For that, the prior definition of a common space, called server, is required to harmonize the data. In this way it is possible to connect the different agents from the beginning of the process. Also, through the server, all involved individuals in the project can work at the same time and visualize the changes that other team members have done. To do this, a restriction and opening protocol was established attending to each user's schedule and circumstances, so they can know, implement, or modify the data.

Likewise, a historical architecture template was required since there are no specific architectural heritage templates nowadays. Templates are empty files used to start the projects according to quality standards in response to the project's organization, the development planning, the optimisation of workflow, the nomenclature control, and the definition of appropriate views: international standards, such as ISO or DIN. This enabled the methodology definition and the characterisation of elements and parameters in order to facilitate an optimized workflow. In order to design the heritage template, the standardization of the characteristic elements of the medieval monuments were sought. Often, a convergence of styles, materials' reuse, and, sometimes, previous restorations, are found in monuments. Therefore, an analysis and recognition of the medieval architecture's constructive elements and materials was done. On the other hand, the traditional precepts to design any kind of architectural template have been adapted to the medieval architecture. Appropriate graphics have been defined for restoration projects as well as generic families developed following geometric figures, the level of detail, the different views, and the sheets' design.

To complete the traditional data collection previously undertaken, a scanning plan was outlined to proceed with the data capture using a laser scanner. The field survey involved multiple positionings of the scanner to cover many directions and obtain information from all points of the building. The field survey basis were: the target's placement, the target's nomenclature, and to determine the different scans' speeds and quality. Also, the scans were done following a linked stream connection, called alignment. Subsequently, office survey consist in linking and cleaning the noise—which are all those figures and improper elements of the building studied that hinder the understanding—and was carried out with the software from Leica Geosystems called Cyclone 8.1.

The "Scan to BIM" (Xiong et al. 2013) study's conclusions were taken into consideration as to introduce the point cloud in the HBIM model, and then, the different ways to import were tested. Consequently, the introduction of the point cloud in the modelling software was achieved without any loss of information through direct importation with the software Revit 2015, which contains a tool to attach point cloud files.

In order to import the point cloud, different extensions were used, such E57 or. rcp. The latter one comes from the point cloud treatment software called Recap, from Autodesk Company. Recap has been used to section the point cloud—to introduce them in the family files—and to change file extensions.

The laser scanner data collection means a precise knowledge of the current state of the historic building, even if not of the previous phases. Which was found out after the analysis of a deep historic study aimed to determine the constructive phases. The "constructive phases" BIM tool for new building has been adapted for the patrimonial architecture as the "historical periods" with great success since it has allowed to represent, in one single model, the different stages of the monument.

A total of five historical periods have been created, and each element of the model has been annexed to one of these. Thus, the state of the building in each historical phase has been represented. The criteria to represent these stages have been based on the moments in which building's changes have been documented. These have been: 13th century, 14th century, 17th century, 19th century, and 21st century. The modelling started from the most ancient phase to the most modern one, in accordance with the logical order of the History and the real process of construction, as Autodesk methodology advised. A creation phase and a demolition phase were also applied to each item. Therefore, when putting a phase filter, the virtual building's construction in each moment appears. The general modelling began by opening a new project with the historical architecture template, previously designed; then the users' profiles were generated to give access to the central model —that is the master file where all of the changes done by other users can be seen. Because our model comes from the point cloud, which has a large amount of information, it is required to establish detail restrictions to focus on a manageable shape form. It is modelled under parameters that mechanize the work and program the processes to expedite time. Therefore, it is appropriate to anchor the already built elements to prevent unsolicited movements. Another relevant aspect was the nomenclature, given that in BIM it is required to work with search engines based on the element's name (Brumana and Georgopoulos 2014).

Subsequently, the specific modelling was carried out detailing the virtual model through free shape elements; which is very important in heritage projects considering that it is necessary to represent pathologies, crashes, masonry bonding, and deterioration level. In this second phase of detailing the following were modelled: archaeology, according to archaeological reports; the eaves, cornices, mouldings, specific historic plasters; stonework and masonry; the isolated elements, such as the water well and the Islamic fountain; and the terrene that was modelled with great detail. The alterations due to the passage of time, such as flaws and material imperfections, crashes or seats, cracks, etc. were also represented. It is recommended to initially model items as they were designed in its origin, thus the elements created can serve to other users, and the work is more systematic and standardized. If the deformations and pathologies that have reached our days are drawn from the beginning, it would not be possible to apply historical periods.

The model was complemented by *families* that are files with sets of two-dimensional or three-dimensional elements already designed that can be used in the projects and that provide detail to the model. There are not many historic families on the market, hence, the design of our own families of medieval elements was posed. Furthermore, the medieval elements, structures, and ornaments—columns, arches, openings, doors or sculptural elements—are often repeated because in the Middle Ages there were just few manuals or notebooks that the master builders used for obtaining their designs. In fact, in the majority of cases, they built by repetition and copy of the nearby buildings that were used as patterns. This is the concept that has led us to appreciate the usefulness of creating a library of parametric medieval families used not only in this case study, but in any medieval BIM model.

3 Results

Regarding the scanner laser process, there have been a total of 12 scans that were joined in a single point cloud as to create the South Courtyard of San Juan del Hospital. Subsequently, this point cloud was satisfactorily inserted in Revit, making possible the sectioning, concealment, and graphic treatment of the cloud without collapsing the computer capabilities.

The architectural heritage template has also been designed to manage monuments with medieval basis. It includes specificities of this kind of architecture as archaeological remains, medieval constructive systems, or antique materials.

The main result has been the full three-dimensional model of the South Courtyard of San Juan del Hospital, and the specific modelling of the elements that compose it, such as the archaeological remains, the historical walls, the Funerary Chapel, the annexed buildings already demolished, and the Empress Constance Crypt.

The historical phases that have arisen in the monument have been represented in one single model: 13th, 14th, 17th, 19th, and 21st centuries. The implications are the possibility of time management and the disposal of a virtual construction model that represents the building's history with all its information. It is especially useful for monuments with medieval origin given the large number of construction phases, demolitions, reutilization of structures, walls' reinforcements, and rooms' reuses. With this tool it is much easier and simpler to represent the story of the building in a virtual model. Consequently, this is, without doubt, one of the most notable advantages of using HBIM for historic projects and researches.

Another result has been the establishment of standardized BIM families with the most characteristic elements of the medieval architecture: gothic arch, semicircular arch, rose window, pilaster, round-arch flared window, pointed window, wall anchors, arcosolia, funerary steles, gargoyles, ribbed vault, and barrel vault. Also, a basic library of medieval heritage materials has been generated: Valencia earth wall, stonework, stone masonry, hard-packed earth, Arabic tiles, lime plaster and solid brick masonry, rough limestone, natural drying solid brick wall, and rowlock brick. This library is really interesting because it could be reused for future consumers.

The modelling process has resulted in the creation of typical medieval constructive elements existing in the South Courtyard of San Juan. These are the double-wall stonework with interior stuffing, the connection between an arc and the masonry stuffing, and the ribbed vault linked with a gothic arc.

As method limitations, it is noted that the initial geometric modelling is time costly since it reproduces the original constructive process and all the parameters needed to be defined. In addition, working with point clouds requires specific expensive programs and powerful computers in terms of RAM—it is the memory or information storage in a computer that is used to store running programs and data for the programs—at least 16 GB.

4 Conclusions of HBIM Modelling

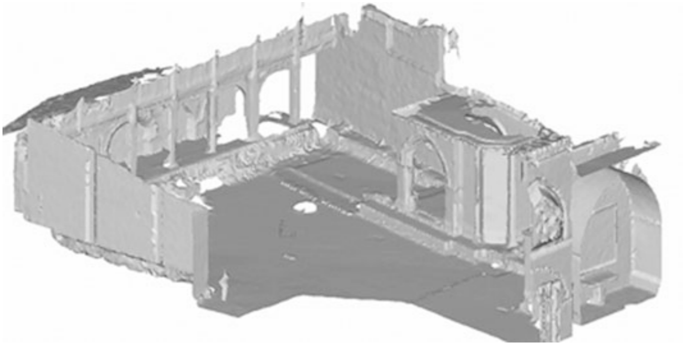
It is argued that the geometrical HBIM model is more useful for the historical buildings' management that the simple point clouds models or the photogrammetry. This is due to the possibility of introducing historical phases and the fact of having associated databases, which is considered a contribution in the "Scan to BIM" field. In addition, with the HBIM model, a virtual construction is obtained, and it requires a cognitive process to achieve a deep knowledge of the case study building.

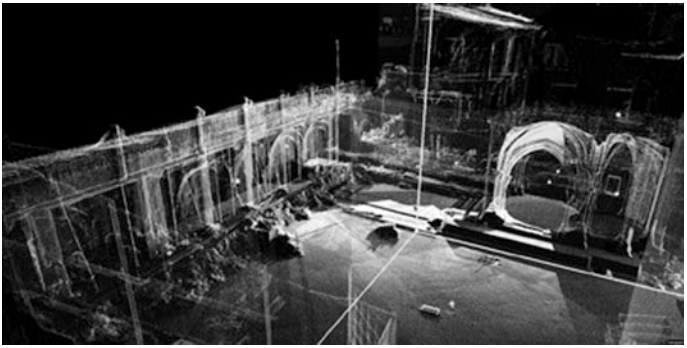
Likewise, it is shown that the HBIM model minimizes errors because it updated all views in real time (including the two-dimensional) and because different people work in the same model so the data is synchronized and it is double checked, reducing the potential of human error.

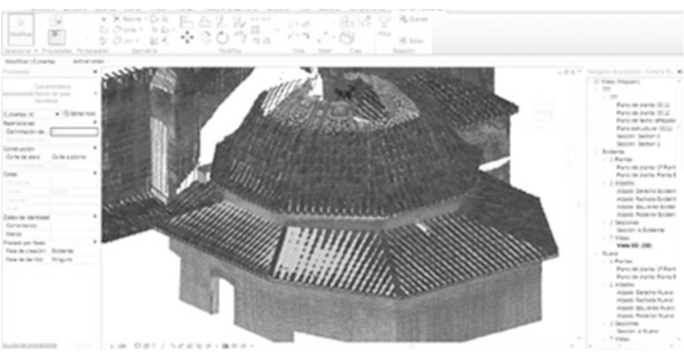
The standardization and geometrization of patrimonial structures has been revealed as highly advantageous because in the Middle Ages it was built with great geometric awareness and because many elements are repeated, both in the same and in other buildings. Which is a natural fact given that, at that time, they had limited number of patterns and the master builders copied many elements of the nearby places.

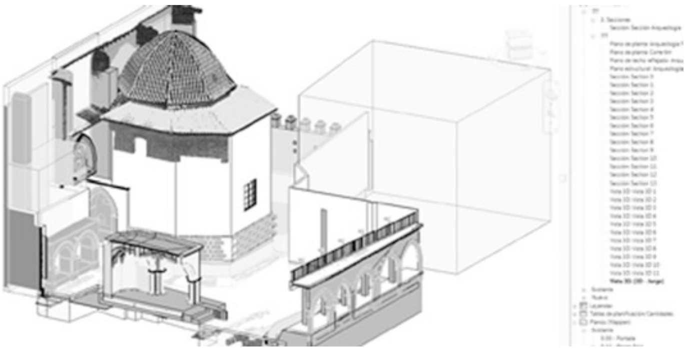
Thus, the creation of standardized elements as the medieval template, a historic medieval library, and a library of theoretical typological families. Which are very valuable for the study and the analysis of the medieval architectural heritage. In the Middle Ages, the concept of originality was more limited and more repetitive than nowadays.

On the other hand, the representation of the historical and constructive evolution with all their data on a single model has produced very good results in this historic virtual model. This success is due to the crowd of constructive phases that the historic buildings used to accumulate and that generate lots of dispersed information. With HBIM, knowledge and information have been reunified; however, this concept is still in development and it is offered as an emerging working line.









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Environmental Analysis Processes and Algorithmic Design. An Educational Experience

Camilo Andrés Cifuentes Quin

Abstract Since the publication in 1948 of Norbert Wiener's *Cybernetics,* the information paradigm has exerted a profound influence in practically all fields of western knowledge. This influence has been decisive for the development of two lines of research in architecture, the environmental conception of space and computational design, which represent an important paradigm shift in the profession. From the identification of the common aspects between these two lines of research, this paper presents a diagrammatic design model, grounded on the use of parametric design tools, which allows the integration of the environmental analysis of architecture and the digital production of space. The development of such a model is a contribution to the discussion about how to instrumentalize the environmental analysis of architecture, and it constitutes a pedagogic tool that endorses the use of digital design techniques as a support for the production of an architecture capable of responding properly to its context.

Keywords Environmental analysis · Digital architecture · Parametric modeling · Diagram

1 Cybernetics, Digital Design and the Environmental Conception of Architecture

In recent decades there has been an important paradigm shift in the field of architecture that has come hand in hand with the introduction of an informational pragmatic and ontology in the profession. This paradigm shift is represented by two lines of research that keep a clear link, namely, the environmental conception of the built space and computational architectural design.

Crucially, the paradigm of thought fostered by the cybernetic model has played an important role in the development of these two lines of research. This scientific

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model, which consolidated around the idea that diverse phenomena can be explained as information exchange processes, defined an agenda for the study of diverse phenomena as systems, that is, as sets of interconnected elements whose relations produce an organized totality (Wiener 1948).

In reference to the notions promoted by cybernetic thinking the environmental (or atmospheric) investigations, as well as the computer based design researches, have explored a vision of architectural objects as cybernetic systems, that is, as the result of the multiple factors and forces involved in the consolidation of a spatial reality (Sprecher 2012).

From this perspective the environmental approaches have fostered a vision of architectural and urban spaces as complex realities characterized not only by their physical aspects, but by the various factors (material, climatic, geographic, social, etc.) that define the built environment. Thus, according to the Cresson laboratory, the conception of architecture around the notion of "ambience" implies the consideration of "the multiple dimensions of in situ perception and of the practices of the built space, as well as … the instrumentalization of the perceptible ambience in the project." (Cresson 2012). In this sense architectural objects have been thought as systems, or as ecologies (in the broadest sense of the word). In consequence, as it has been stated by the architectural critic Sanford Kwinter, buildings have ceased to be thought as individual units to be conceived as the set of relations that define an architectural or urban artifact (Kwinter 2001).

This is by far the same vision of disciplinary problems endorsed by the investigations on informatics and architecture. Ever since the first investigations that explored the introduction of informatics in architectural design, developed in Cambridge during the 1960s, the use of information technology in this field has been conceived as a means of exploration of new design paradigms informed by different fields of knowledge linked to the cybernetic paradigm; among them structuralism, linguistics, systems analysis and operations research, among others (Keller 2005; Rocha 2004).

In the same way, in reference to the former and other scientific models (including systems theory, molecular biology, bioinformatics and complexity science), various contemporary investigations on digital design have explored a pragmatic of design based on the definition of dynamic processes to deduce the architectural form, the inclusion of data flows as the input of the design problem, the automation of design through the use of algorithmic techniques, as well as the conception of the architectural project as a problem solving question (Cifuentes 2014).

Just as in the environmental researches, the digital practices of design have promoted a vision of the disciplinary problems grounded on the conception of architectural objects as the result of the systemic relations among the different elements that define a spatial reality. Therefore, the cybernetic vision of architecture has been inseparable of the development of various (genetic, parametric, formation) digital design models where the spatial description of the project has been replaced by the analysis of the relations among the elements involved in an architectural problem.

Due to the former, digital design models have raised as the ideal tool to instrumentalize the environmental analysis of architecture in the practice of design. Further down is presented the potential of parametric design in this regard.

2 The Cybernetics of Parametric Design

The relational logic fostered by the cybernetic vision of architecture is implicit in the development of parametric design tools. The former is particularly evident in the transformation in the practice of design that they promote; specifi, the move from the explicit geometric notation of architecture to the defi of the designed object by means of the setup of instrumental geometric relations, where the particular elements of a design can be constructed as responses to specifi variables, or parameters, represented by mathematical expressions and codes on an algorithm (Woodbury 2010).

Therefore, the parameters of an algorithm can define the characteristics (form, size, orientation, position) of the geometric elements (lines, points, polygons, volumes, surfaces) of a designed object, or they can define variables that affect the relations among such elements. So, in addition to the control of the geometric properties of the designed objects, parameters can also determine the dependency relations among them. Thus, when a designer uses a parametric system what is created is a collection of objects subject to a system of flexible relationships defined by a program (Menges 2006).

In this sense parametric modeling is a tool that allows the evaluation of the architectural project according to the design variables established by the designer as well as the analysis, facilitated by the manipulation of such variables, of multiple possible solutions to a design problem. The possibility of thinking of the designed object as a system of variable relations makes of parametric modeling the ideal instrument for the development of a practice of architecture informed by the environmental analysis of space.

3 Towards the Integration of Parametric Modeling and the Environmental Analysis of Space

As it was mentioned before, the environmental analysis of architecture fosters a vision of the living space as the result of the interaction of multiple factors including social, perceptual and material aspects, among others. Consequently this type of analysis has been conceived as a support to achieve a proper balance among the architectural project, its requirements, and the conditions of a given context.

Two specific aspects of parametric tools present an interesting potential in this regard; on the one hand, the possibility of using data as a control parameter of the designed form, and on the other, the capacity to establish a relational dynamic between the designed form and other variables.

Thanks to these two aspects of parametric tools it is possible to develop design processes informed by the analysis of the different factors involved in the consolidation of an architectural or urban reality; thus it is possible to use the results of the environmental analysis of space by entering the obtained data as input for the production of form.

In order to explore the potential of parametric modeling as a means to instrumentalize the environmental analysis of architecture it has developed a diagrammatic design methodology based on the use of digital design and simulation techniques. The model presented below is a contribution to the debate about how to render operative the environmental analysis in the practice of design, and it is part of a teaching experience oriented towards the use of algorithmic design as a means for producing an architecture capable of responding to the various factors that define a design problem.

4 From the Diagram to the Object

The developed model endorses a practice of design based on the use of the diagram as an instrument that renders operative the environmental analysis in the production of the architectural form. According to Alexander, “any pattern which, by being abstracted from a real situation, conveys the physical influence of certain demands or forces is a diagram.” (Alexander 1986). In this sense the diagram is not only an ideal medium to design an architecture capable of responding properly to its context, but un instrument that permits to clarify what is the context in which the architectural object is implanted.

Considering the above, the model fosters a diagramatic practice of architecture founded on the permanent feedback between the analysis and realization phases of the design process; the former through the mediation a prametric modeling tool. In this way it is intended to define the architectural form in base of the evaluation of the correct adaptation among the designed object, the analyzed conditions and the requirements of the design problem.

The model includes five interrelated points: (1) Analysis of the environmental phenomena considered relevant for the design problem. (2) Elaboration of analytic diagrams corresponding to the visual representation of the properties of the studied phenomena. (3) Production of formal diagrams that define the architectural form in base of the results of the analysis. (4) Study of the proper adaptation between the analyzed conditions, the project requirements and the design hypothesis elaborated in point three. (5) Final design (Fig. 1).

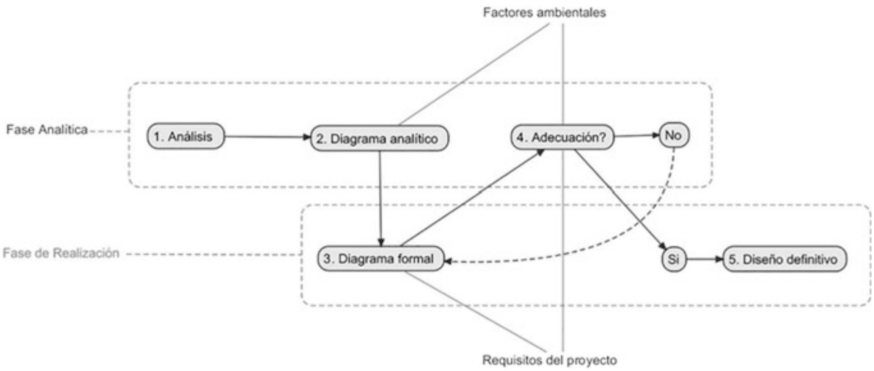

Fig. 1 This diagram shows the five points of the described design process, corresponding to an analytic and a realization phase that are constructed together as a feedback process

The first point consists in producing the analysis of the environmental factors (lighting, acoustic, thermal, perceptual and usage aspects, etc.) considered fundamental for the solution of a determined design problem. According to the results of this analysis it is proposed, in the second point, the development of the analytic diagrams, that is, the production of visual representations of the collected data, the graphical expression of a set of properties of a particular phenomenon.

The third point defines a work on the architectural form informed by the results of the analysis. In this realization phase the diagram is used as the representation of a basic design idea that expresses the physical characteristics of the proposal as a response to the project requirements and the analyzed factors in the previous phases.

The fourth point involves the evaluation of the design proposal in relation to the analyzed factors and the project's requirements. If it is considered that there is a proper fit between the designed form, the project requirements and the analyzed criteria, the outlined form can be used in a final phase of realization, point five, to develop a final design.

Thanks to the mediation of parametric modeling tools it is possible to establish the necessary integration between analytic and realization phases.

As an analytic tool, thanks to the possibility of manipulating information flows, parametric design software can be used as an instrument of representation of the analyzed data. In terms of the production of form, the very own relational logic of parametric tools is an effective way to explore the adequacy of the designed shape in relation to the conclusions drawn from the analysis. This makes it possible to establish a logical feedback between design and analysis, so that the adequacy of the solution to a design problem can be examined, and the results of the analysis can be reintroduced into the process to refine the design.

Through the application of the design model formerly described, the following design exercise has been developed as a way of illustrating the proposed method.

Fig. 2 Location of the Barcelona School of Design and Engineering

5 The Model Applied

The context of the developed project[1] is the central court of the building of the Barcelona School of Design and Engineering, which is located in Barcelona's central district, next to the Rambla of Santa Monica and the Joaquim Xirau square (Figs. 2 and 3).

The proposed design exercise consists in projecting an architectural intervention in the aforementioned space that should meet the requirement of partially covering the school's court, a space which, due to its location, receives much direct sunlight during the summer and very little during the other periods of the year. Following the points of the model, the design process is developed in five stages corresponding to an analytic phase and an implementation phase which feedback each other until the production of a final design. All phases of the process were defined by a single algorithm in *Grasshopper*®, a method which permits the use of the data resulting from the analysis to generate analytical and formal diagrams, as well as the evaluation of different design scenarios and the introduction of new variables of analysis at any stage of the process (Figs. 4 and 5).

Step 1. Given the requirement of partially covering the space, and its vocation as a meeting place, the exercise started from a comparative analysis of the occupation patterns of the court in relation to its insolation. The former with the aim of defining the architectural form as a response to the needs exhibited by the users during the analyzed periods. The occupation analysis was made through the in situ observation and photographic record of the activity of the court during the daylight hours of various days. The insolation

[1]For the realization of this project has been used artwork and the data collected, in collaboration with Ignacio Arciniegas, for the elaboration of an exercise framed into the activities of the Master *Advanced Design and Digital Architecture*—ELISAVA.

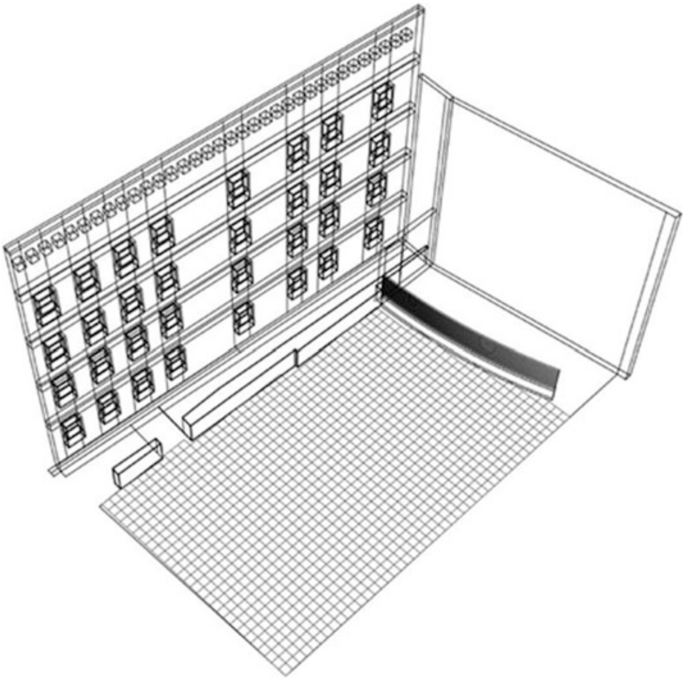

Fig. 3 Axonometric view of the central court of Barcelona School of Design and Engineering

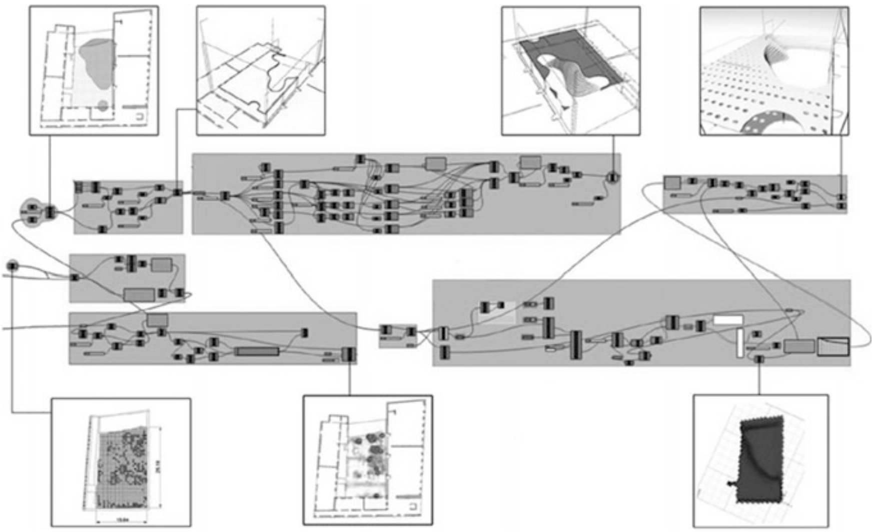

Fig. 4 Generative algorithm in *Grasshopper*® that includes the five phases of analysis and synthesis of the form

Fig. 5 Photographic record of the activity of the court during different times of the day

analysis was made using *Ecotect*®—for the period comprised between March 21 and June 21—and the plug-in *Geco*® was employed to introduce the results of the *Ecotect*® analysis in the *Grasshopper*® definition.

Step 2. After the development of the occupation and insolation analysis, the obtained data were mapped into a matrix representing the space of the court. The solar analysis was mapped by assigning a color code, obtained from the *Ecotect*® analysis, to each cell in the matrix. In order to map the results of the occupation analysis was created a collection of images, each one of them representing the occupation of space during a given moment. In this way a global occupation factor was assigned to each point in the space in order to assess which are the zones that register more daily activity (Fig. 6). Using the image sample tool of *Grasshopper*® it was possible to analyze graphically the global occupation value of each point in the space. Afterwards was produced a comparative diagram of the results of the occupation analysis and the insolation maps obtained from the *Ecotect*® analysis (Fig. 7).

Step 3. The overlapping of the occupation diagram with the insolation analysis confirms that, during the studied period, the most used spaces of the court are those that receive more direct solar radiation. According to this observation, and using analyzed data, was produced a diagram showing the patio areas that should remain uncovered to receive maximum solar

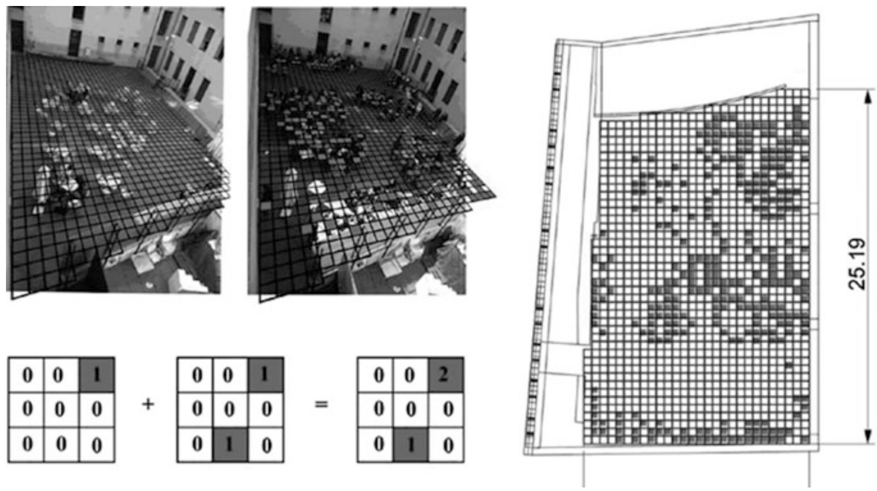

Fig. 6 Data mapping of the information obtained through the occupation analysis in a two dimensional representation of space. For each registered moment each cell in the matrix receives a value of *1*, when it is occupied, and a value of *0* when it is empty. The mass addition of all the obtained values permits to determine a total occupation factor for each cell in the matrix

Fig. 7 The image on the *left* corresponds to the graphical representation of the occupation values resulting from the process described in Fig. 6. The occupation of each point in space is represented by a circle whose size and color varies depending on the obtained value. The diagram on the *right* is the result of overlapping the representation of the highest occupation values and the graphic representation of the global insolation values

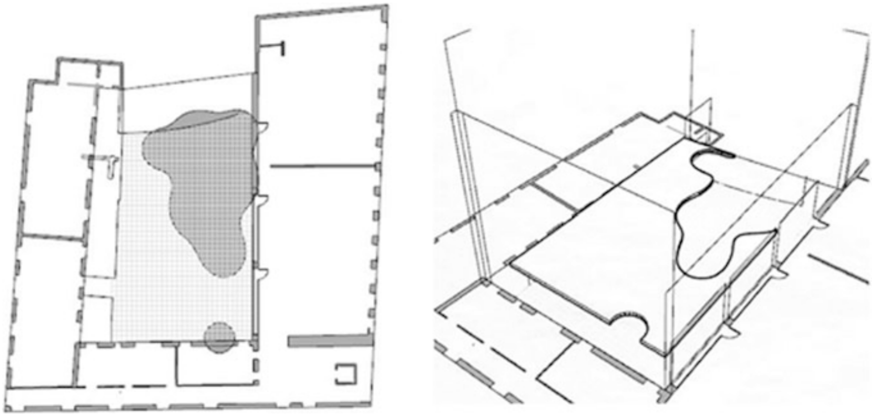

Fig. 8 The image on the *left* is the synthetic diagram that interprets as a form the analysis results. The figure on the *right* represents the first step towards the materialization as an architectural object of the synthetic diagram on the *left*

radiation during non-summer seasons. This synthetic diagram was developed as an instrument to generate a formal pattern in terms of the fit between the project requirements and the results of the analysis. In base of this diagram of form was proposed the construction of a flat roof that permits, on the one hand, to partially cover the court, leaving uncovered the area that receives more solar radiation during non-summer periods, and, on the other, to create a terrace on the upper level that duplicates the area of the covered part of the court. Like this the court can have a protected zone during the summer period and keep the same surface of exterior areas without covering the zones of the patio that receive direct solar radiation during non-summer seasons (Fig. 8).

Step 4. Once defined a basic architectural form a new feedback loop between the analysis and the synthesis phases was launched with the aim of studying the best fit among the designed form and the insolation of the court during the period comprised between September 21 and the June 21. For this purpose it was analyzed the insolation of diverse variations of the designed space to determine an ideal compromise between covered and uncovered areas (Fig. 9).

Step 5. Once defined the proper fit between the form of the roof and the insolation of the projected space, the final design of the space was completed with the development of a set of ladders that work as an element of solar control, as a permeable limit that divides the covered and uncovered zones, and as a grandstand that functions as furniture and as a stair to access the roof. On the roof were created a series of openings that allow a controlled passage of sunlight. These elements were also defined parametrically, so that in this phase it was also possible to analyze different spatial configurations in base of the variables introduced in the generative algorithm. Therefore, the form

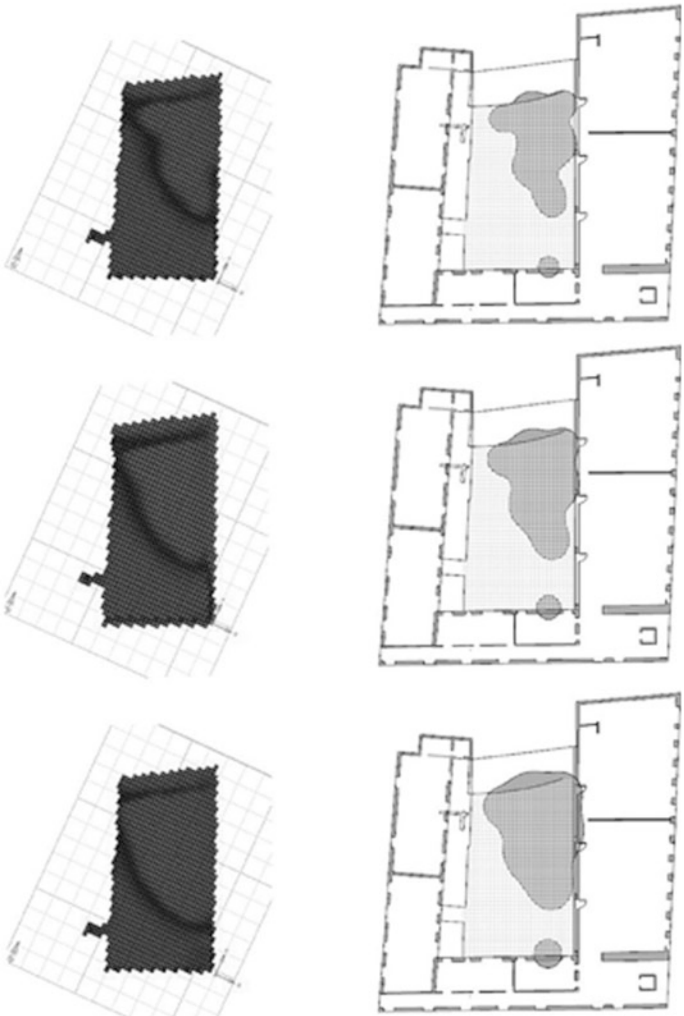

Fig. 9 Analysis of different possible configurations of the project according to the insolation analysis of the designed space

of the grandstand depends of the variables defined in the step 3, so that any variation introduced in this point has an incidence in the final design. In the same way the openings of the roof were created in relation to the data obtained in the solar analysis. The diameter of the wholes varies according to the amount of direct solar radiation received by the roof; where the insolation values are high the wholes have small diameters and vice versa (Fig. 10).

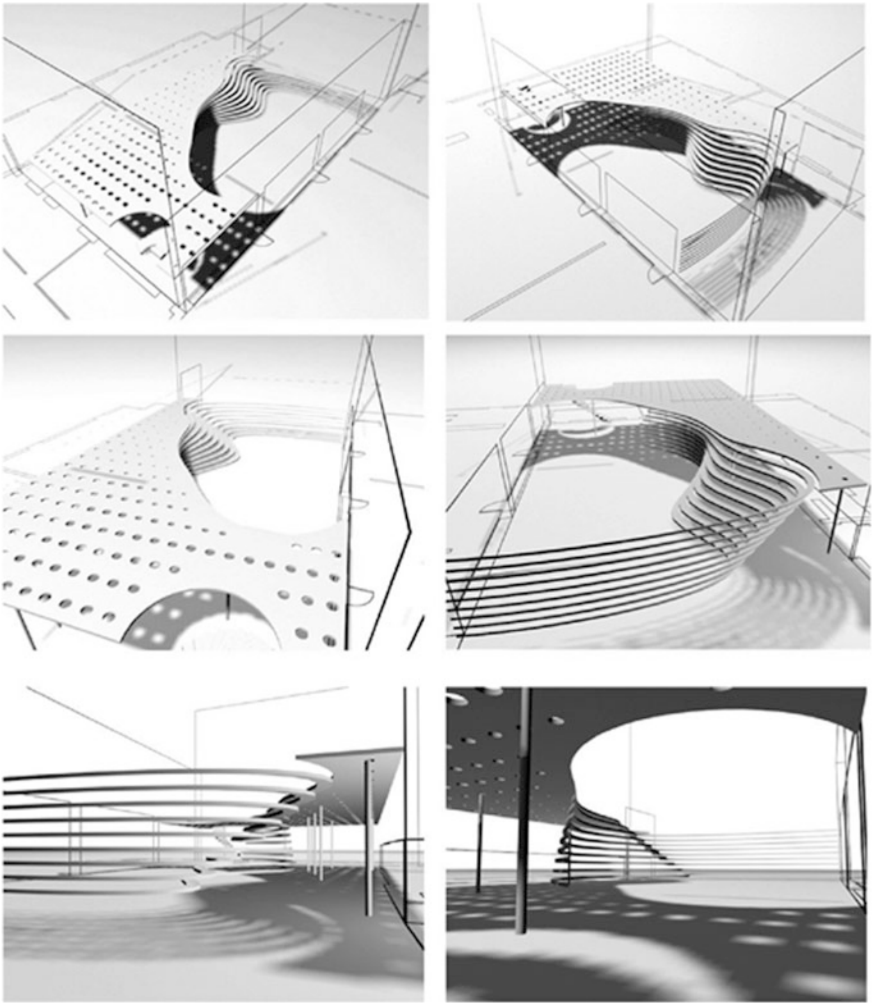

Fig. 10 Perspective views of the project illustrating one of the possible results of the design process

6 Conclusions

The exercise described above is an example of the possibilities offered by computational tools as a means to instrumentalize the environmental analysis of architecture in the design process. The developed model exemplifies how an algorithmic design technique allows the introduction of the results of this kind of analysis as an active element in design. The former thanks to the possibility of establishing a causal relationship between the information obtained through the analysis and the production of the architectural object, starting with the development of the first formal diagrams until the development of a final design.

The presented model integrates elements of the environmental researches in architecture as well as comrputational design methods. The latter by exploring a feedback logic in the practice of architectural design, where space is not explicitly defined by its geometric representation, but through the understanding of the systemic relationships between different aspects involved in the definition of the project.

Although the model is of interest as a contribution to the discussion on how to operationalize the environmental analysis of space in the practice of architectural design, an approach of this kind involves certain restrictions. The need, implicit in computational pragmatics, to work with quantitative data represents a clear limitation, as not all factors involved in the production of space can be analyzed using quantitative techniques or be expressed through mathematical formalizations.

Because of this the digital production of architecture is not considered here as a substitute for the traditional tools and practices of the profession, but as a medium that allows to equip the practice of design with new instruments that permit to evaluate the best fit between the designed object and a variety of factors involved in the consolidation of architectural space.

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Steven Holl: From the Hinged Space to the Chromatic Space

M. Teresa Díez Blanco

Abstract By 1983, Steven Holl had begun experimenting with so-called 'hinged space' in a series of apartments in Manhattan based on a planar and linear vision of architecture. Therefore, a parallel could be drawn with De Stijl group and their neoplastic paintings. Projects like housing in Fukuoka and Storefront gallery are evolved examples of the same ideas. The creation of 'chromatic space'—another term coined by Holl—is analyzed through D.E. Shaw and Sarphatistraat offices renovation, where the phenomena of spatial colour reflection are explored, thereby establishing new points in common with the chromatic architecture of the Dutch group.

Keywords Steven Holl · Neoplasticism · Planar architecture

By 1983, Steven Holl had begun experimenting with so-called 'hinged space' in a series of apartments in Manhattan, such as the Cohen apartment and the XYZ of the MoMA tower, which featured partitions with moving parts fully integrated into the wall, simulating planes rotating on a vertical axis. The fact that these panels had unusual shapes (inverted L or T) helped to further blur the concepts of doors and partitions when in use.

In his book *Parallax*, the American architect defined hinged space as the transformation of an autonomous space into an interactive space consisting of 'participating walls', which he himself described as a hybrid between fixed and hinged walls, whose function was to rearrange the domestic habitat in order to suit user needs. The aim was, in short, to create a dynamic space with movement, as set by deconstructivist trends (according to Holl this was unsuccessful, as it addresses changing architecture in form but is static in its execution): "The then-current polemics of 'deconstruction' led other designers to create twisted grids, shards of walls, and tortured folds. When their geometries were built, space was frozen into a caricature of the dynamic" (Holl 2000, 230).

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Therefore, the architect created a number of domestic areas with moving partitions, thereby altering the perception of the created space as a result of changing the parallax: term that he adapted to the architectural and urban field, defining it as "the change in the arrangement of surfaces defining space due to the change position of a viewer" (Holl 2003, 80). The approach to architecture in which what matters is the perceptual experience of the viewer, implying a manner of operating that starts with a preview drawn in perspective prior to the plans. That is to say, during the design process the exploration of the space from the closest possible viewpoint to direct vision is used, avoiding abstract planar representations. As explained by Steven Holl himself: "Instead of a priori plans projected later into perspective drawings, perspective views are made and cast backwards into plan fragments" (Holl 2003, 80).

In the 1983 renovation of the Cohen apartment, the existing walls of the rooms were torn down leaving the old beam system exposed. Holl chose not to partition the main sections, thus creating a sequence of concatenated spaces made up of the dining room, living room and study, framed only by the structure of pillars and girders.

In terms of design, the proposal was based on three basic compositional types: linear, volumetric and planar. Therefore, the dining area was dominated with furniture in linear forms, the living room featured volumetric motifs, and both the studio and bedroom featured planar compositions based on rectangles and squares. In fact, for the partition between these last two areas, two rectangular wall segments were cut out that could be opened or closed, both visually (by way of a window) and physically (by way of a pivoting door), communicating the areas which would constitute the source of the hinged space (Fig. 1).

Lastly, since the views from the apartment are only nearby skyscrapers, the architect wanted to give the interior space its own horizon in the form of a sheet metal strip running along the vertical elements (walls, pillars and hinged panels), chromatically dividing them into two distinct parts: the plaster below the strip is cream coloured, while the part above it and the ceiling are painted light blue. With this, the combined parts are unified.

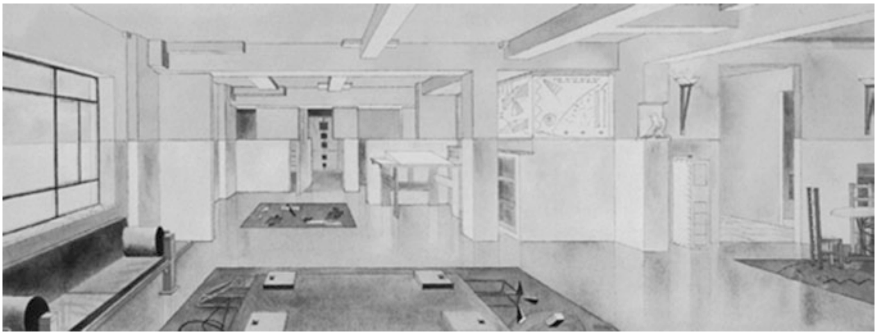


Fig. 1 Perspective of the Cohen Apartment from living room toward study and bedroom. Steven Holl Architects (SHA), 1983 (Holl 2012, 22)

Parallels can be drawn from the above with some of the tenets of the Dutch group De Stijl. On the one hand, the refining of shapes down to their fundamental components: lines and planes. On the other, a taste for straight angle geometry, present on walls and in the furniture. In this regard, the front of the bedroom closet should be noted, whose composition is based on squares and rectangles of various sizes, recalling the neoplastic paintings of members of the group such as Theo Van Doesburg.[1]

For the interior renovation of the MoMA tower apartment in 1987, Steven Holl also started from a simple geometric concept: the organisation and distribution of the various elements following the directions of the coordinate axes X, Y and Z. Therefore, the walls located along the X axis are painted entirely charcoal black, while those on the Y are yellow (perhaps he wanted to create a light/dark effect). The Z direction is represented by the vertical lines of the furniture, emphasised by two long, narrow lamps in the corners.

This combination of coloured surfaces and lines makes the interior space seem entirely planar, which brings us back to De Stijl and its concept of architecture, especially due to the use of colour to alter the perception of the existing volume, visually reducing the composition of planes. But also due to the overall approach to the interior, including furniture, in order to create a spatial interaction between the parts, in which an object located in one position simultaneously serves as a reference for another. That is, as in neoplastic architecture, each part is visually independent from the other and, at the same time, interacts with the entire composition. In this sense, it is worth mentioning the free-standing wall that separates the dining area from the living area, as well as the access door to the bedroom, made up of a hinged panel with two parts that turn and frame the view of the other 'rotational wall' (in Holl's own words) located behind it. This last one is, in reality, a wardrobe with various doors and drawers that fit together like pieces of a puzzle, creating a highly dynamic effect. The furniture, specially designed for the apartment, includes a dining table with the XYZ direction marked in its centre using a geometric motif reminiscent of the painting *Composition* $y = 2x^2/5$ *with Red* (1931) by the sculptor and neoplasticist Georges Vantongerloo (Figs. 2 and 3).

1 Interior Hinged Space

Between 1989 and 1991, Steven Holl built a housing in Fukuoka (Japan), starting again from the notion of 'hinged space' for the interior layout of the apartments. The proposal was to carry out an active renovation of the entire domestic habitat,

[1]See Van Doesburg, *Arithmetic composition*, 1929–30.

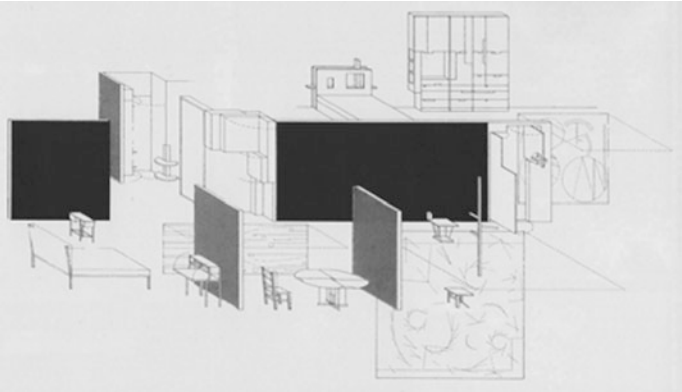
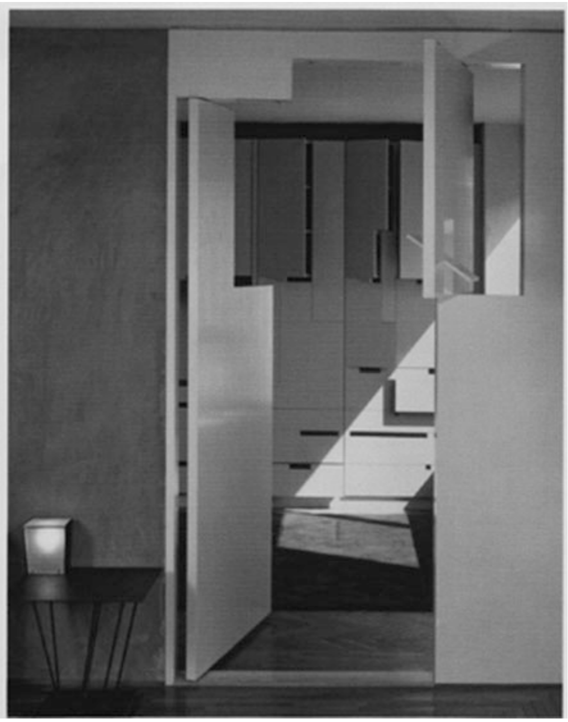


Fig. 2 Axonometry of the MoMA Tower Apartment. SHA, 1987 (Holl 2012, 32)

Fig. 3 Interior view from the door of the bedroom. SHA, 1987 (Holl 2012, 33)



meaning it was possible to make changes or variations depending on the use and needs of the moment. All of this was to make the most of the available floor space; something essential in large cities, where the scarcity of buildable square metres raises prices exorbitantly.

Therefore, compared to the classic domestic space, defined from the aggregation of separate rooms by fixed walls (in other words, housing with one, two or three bedrooms) the American architect created an interior distribution based on mobile partitions in order to obtain areas whose spatial organisation could be changed to another. In this way, the concept of space based on a defined volume disappeared, bringing us back to neoplastic principle: "The new architecture is anti-cubic, i.e., it does not strive to contain the different functional space cells in a single closed cube".

To do this, Holl used the qualities of the traditional Japanese domestic space as a base and the many ways in which the Japanese make use of it by employing mechanisms such as screens and sliding doors (called *fusuma* if they are opaque and *shoji* if they are translucent). Using this approach, he creates a modern interpretation of the Japanese *fusuma* using pivoting wooden doors, panels and cabinets which can be moved at will, making it possible to unite or divide pieces, according to temporal, cyclical or sporadic changes (bedrooms can be converted into living areas during the day, can be resized when children are born, when children leave home, etc.), thus providing the space flexibility and dynamism. This way, by rotating a number of wall segments, the different areas are no longer compartmentalised so that continuity and smoothness is achieved between spaces (Fig. 4).

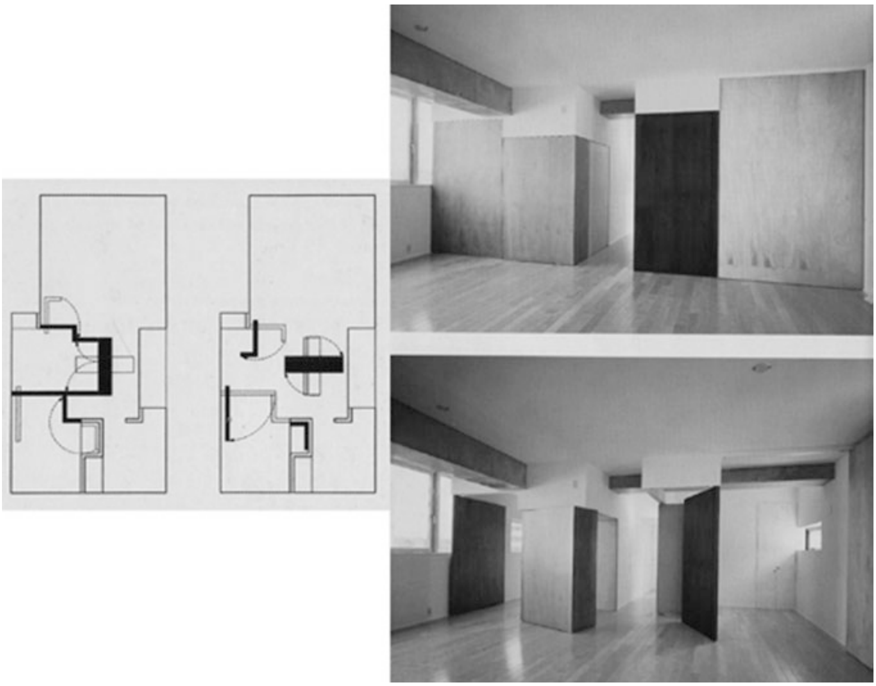


Fig. 4 Diagram of the hinged space and interior views. SHA, Matsuo Photo Atelier, 1990 (Holl 2000, 232–233)

In some cases, the corners of the rooms can even disappear completely as no two apartments are the same; each is organised according to a different distribution. In fact, each panel is painted following a permutation of colours, from natural wood to black, thus creating different chromatic compositions which help bring the focus to these elements. Overall, the feeling is that of being immersed in a somewhat abstract interior, in which conventional architectural components like walls have been replaced by hinged planes.

2 Urban Hinged Space

In 1992, Steven Holl and the artist Vito Acconci were commissioned to restore the old façade of the *StoreFront for Art and Architecture*, one of the few galleries dedicated to exhibiting the work of young architects in New York City. This project follows the idea of the pivoting panels of the Fukuoka homes, although with some variations. The most important is that, until then, Holl had applied the concept of hinged space solely to domestic interiors. This transformation to a hinged urban space is expressed in the phrase "rethinking hinged space" that appears in the concept diagram of the project (Fig. 5).

Located on the corner of a block, the gallery is actually a long, narrow wedge where the length of the façade is the dominant dimension. Given that the previous exhibitions held were characterised by multiple cuts and layers of paint that had been accumulated on this wall, it did not seem advisable to design something that implied any permanent treatment of it. Similarly, Holl and Acconci were interested

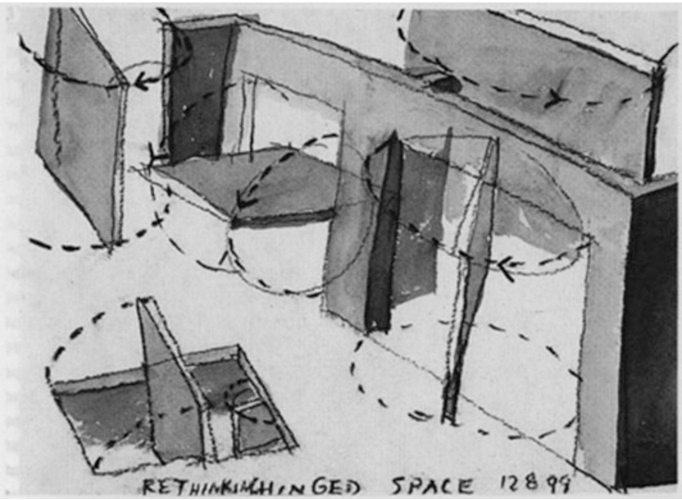


Fig. 5 Concept diagram of the perforatedhinged façade. SHA, 1992 (Holl 2000, 234)

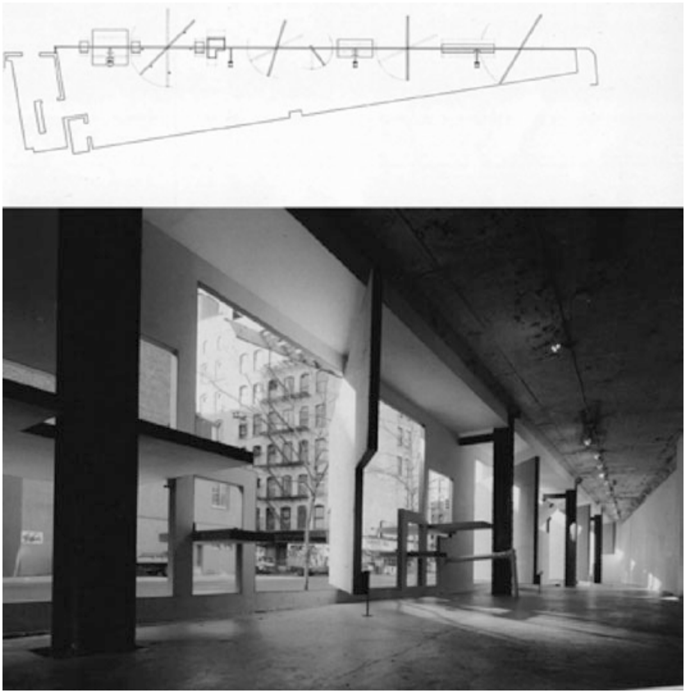


Fig. 6 Final plan project and interior view with the movable panels. SHA, 1993 (Holl 2003, 190)

in achieving an interactive and dynamic exhibition space, a meeting point between the visitor and the artist (conceptual art does not want passive spectators) (Fig. 6).

Based on this, the strategy was to drill into the entire façade wall, inserting twelve pivoting panels made of a composite material (a mixture of concrete and recycled fibres) of various shapes and sizes, which would rotate horizontally or vertically to open the gallery directly onto the street. In this way, they created, firstly, various possible façades depending on the different positions of the panels (even serving as doors, tables and benches), transforming a planar element into a tri-dimensional composition made up of "*a multiplicity of planes*: again *the plane*".[2] The description corresponds to the vision of neoplastic architecture and more specifically, Piet Mondrian.

But furthermore, when the panels are opened up, the façade disappears, and with it, the existing division between the interior space and the street. In 1923, Van Doesburg had written: "The new architecture has disrupted the wall and, in so doing, destroyed the division between inside and outside".[3] Resemblance to the

[2]The italics correspond to the original text (Mondrian 1983).

[3]The quote is part of the manifesto 'Towards a Plastic Architecture', published in *De Stijl* magazine in 1924.

Storefront project is evident. Therefore, the previously private area of the art world expands outward to the general public: life imitates art and art imitates life, just as in the neoplastic ideal. In conclusion, if the main function of a façade is to create a barrier that separates the interior from the exterior space, this new façade, according to Kyong Park, director of the gallery, is "no wall, no barrier, no inside, no space, no building, no place, no institution, no art, no architecture, no Acconti, no Holl, no Storefront" (Holl 2003, 184).

3 Chromatic Space

From a physics standpoint, we can describe colour as a property of light, which depends on the wavelength. However, in 1810 Johann Wolfgang von Goethe opposed this purely scientific view in his treatise 'Theory of Colours', proposing that colour also depends on our perception (an aspect forgotten in Newtonian theories) and placing special emphasis on brightness and contrast as determinants of this fact. Later, discoveries regarding the way in which the brain interprets colours confirmed this.

Steven Holl echoes these ideas in his book *Parallax*, in speaking of what he calls 'chromatic space', referring to this double aspect which includes the objective and the subjective, combining concept and feel. This scientific and aesthetic interest in light and colour shown by the architect, in addition to other key elements like geometry and material, is one of the characteristics of his work, as it gives it a determining value in shaping the architectural space. In his writing "Idea and phenomena", he states: "Space remains in oblivion without light. Light's shadow and shade, its different sources, its opacity, transparency, translucency, and conditions of reflection and refraction intertwine to define or redefine space" (Holl 2003, 90).

Similarly, chromatic space is activated using light beyond the painted surface of a wall or the actual tone of the material, generating halos of colour that tint the surrounding environment through reflection. Thus, by using different systems and types of light, chromatic fields are created that define planes, define volumes and define spaces. In short, it is the space itself and not just the surfaces that surround it, which acquires chromatic qualities.

Holl's interest in the effects of light together with architecture is clearly shown in the Chapel of St. Ignatius, but is manifested in the systematic use of watercolour as a representative medium, and from here other phenomenological considerations may come about, something evident in his Finnish relationships, particularly in the empathy felt by J. Pallasmaa in terms of the user's experience of architecture: "Watercolors allows you to make bodies of light, to go from the bright to the dark. When I am making a series of perspectival views through a series of spaces and thinking about light, watercolor is a better media than line drawing" (Holl 2003, 23) (Fig. 7).

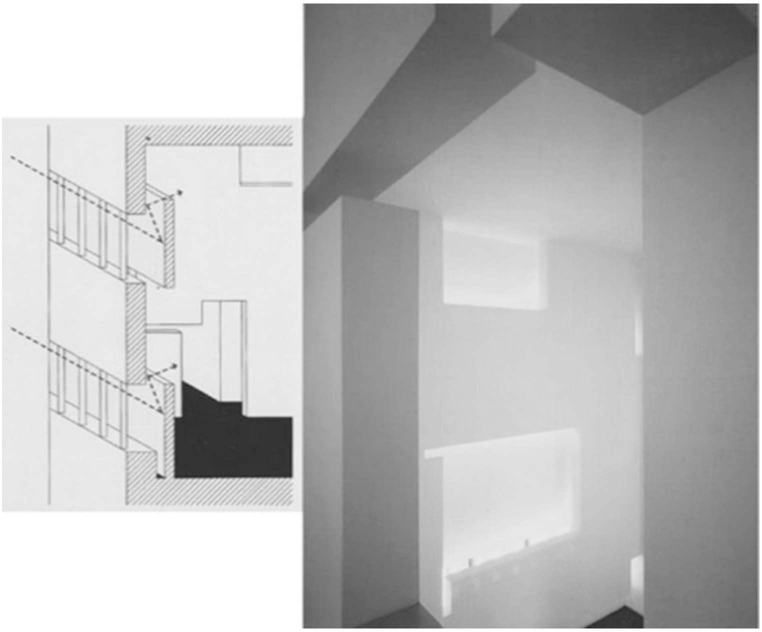


Fig. 7 Colour projection diagram with daylight and view from second level. SHA, 1992 (Holl 2000, 164–165)

In 1991, the creation of a chromatic space was the central concept in the renovation of the offices of the multinational company D.E. Shaw in New York, located on the top two floors of a skyscraper in downtown Manhattan. This project is quite similar to the work of the American artist James Turrell, characterised in turn by the key elements of light and space.

The fact that the firm D.E. Shaw works in managing financial assets helped Holl to establish an analogy between the intangible world of a company working around the clock in the stock market and the design concept, which was based on the placement of colour sources just as invisible to the viewer. This is achieved using wall panels strategically located and painted with bright colours, which act as diffuser colour screens when light strikes them.

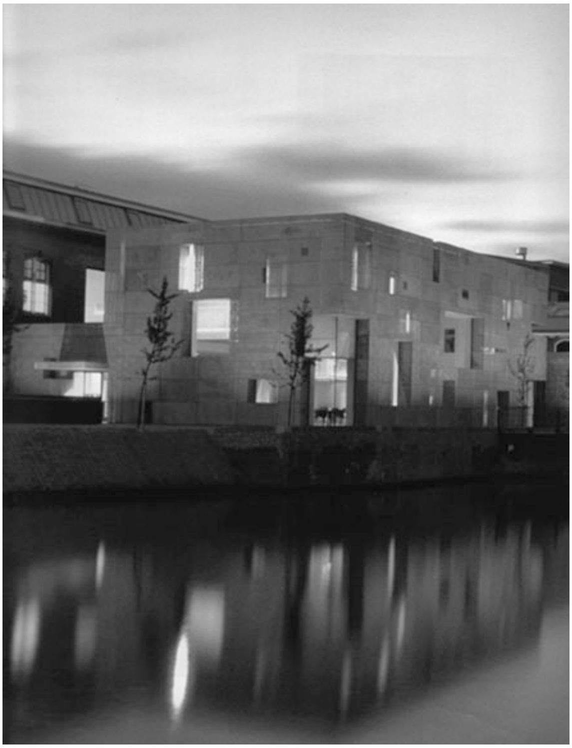
To this end, the American architect converted a double-height lobby with access to the offices into a sort of cube within a cube. On the inner walls of the central structure built with plasterboards, a series of openings and grooves at certain points were made, acting as light modulators. To that effect, at the rear of these partition walls, a colour layer was applied which is hidden to the visitor when within the space and is projected to the rest of the surface through reflection, both with daylight and artificial light, thereby creating chromatic reflections, framing especially the holes that were made. To increase the intensity of the reflected colour, fluorescent paint was used.

With all of this, we can once again find common features with Neoplasticism, mainly in two aspects. Firstly, the use of colour as a key element when defining space; this brings to mind the words of Mondrian: "Neoplastic architecture requires *colour*, without which the plane cannot be a vital reality for us". Secondly, the cuts in the wall in turn serve to accentuate the perception of the interior space as the sum of intertwined surfaces. Therefore, we can conclude that cutting in Steven Holl's architecture has a similar purpose to colour in neoplastic architecture: in both cases they serve to break down volume on planes, breaking with the traditional architectural notion of enclosed and cubic space. For these reasons, we can once again turn to the explanation of the architect himself, standing against post-modernism but also the modern homogeneous and undifferentiated space: "I thought that light, texture, detail, and overlapping space, constituted a meaning that is silent and stronger than any textual manipulation" (Holl 2003, 15).

In the case of the Sarphatistraat offices located on the Singel canal in Amsterdam, a chromatic space was also achieved by using sparkling colours placed at random, which is particularly successful at night when the light inside the building projects dense blocks of colour floating in the water, painting the canal with the reflection (Fig. 8).

The project itself, carried out between 1996 and 2000, involved the renovation of an old office building plus the construction of a pavilion, designed to accommodate

Fig. 8 Night view of the pavilion. SHA, 2000 (Holl 2003, 190)



activities ranging from public meetings to theatrical performances. In the case of this last instance, Holl was inspired by both science and music, by mixing the rational and mathematical form of the ‘Menger sponge’ (a figure full of holes that are repeated in increasingly smaller sections, to the extent that the volume approaches zero and the area infinity) and the randomness of the musical composition “Patterns in a Chromatic Field” by Morton Feldman. The result is an asymmetrical cube-shaped building, riddled with rectangular openings of different sizes, arranged haphazardly in the three dimensions of space, giving it a porous nature. This notion is reinforced by the succession of layers of perforated panels on the façade, made of materials ranging from plywood and aluminium in the interior to copper on the exterior, which act as screens, filtering the light from the openings. Also, squares of fluorescent paint in various hues and of various sizes arbitrarily distributed throughout the different strata of the façade are incorporated to add colour which is enhanced in certain places by lights. There is therefore a permeable porosity in light and reflections, creating a chromatic space changing from the inside out, since the colour increases or decreases in intensity depending on the time of day and type of light. It also addresses planar porosity in which volumes are formed based on the addition of surfaces (Fig. 9).

Some critics have compared Holl’s pavilion (located, by the way, in the country of De Stijl’s origin) to a pattern in a Mondrian painting. The abstract character of the façade, originating from the asymmetric and harmonious effect of the openings and fluorescent squares, definitely brings the experiments of neoplastic architecture, which used planes and colours, to mind.

Another example of spatial abstraction, about which Steven Holl also speaks of ‘planar porosity’ (Holl 2000, 318) is the University of Iowa Art and Art History

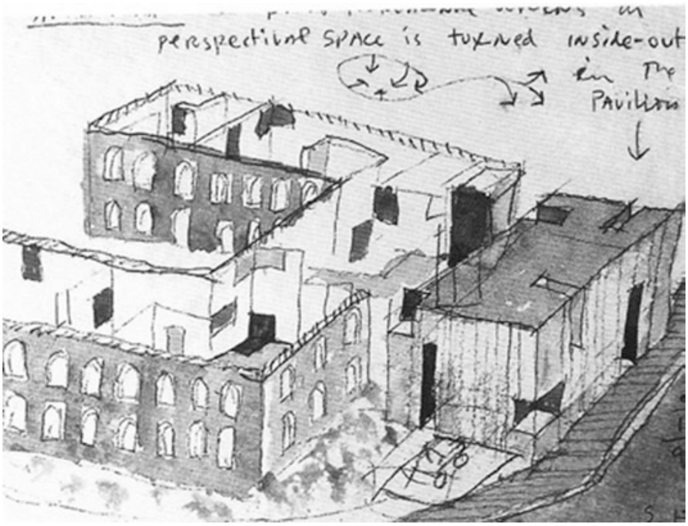


Fig. 9 Initial concept diagram with the colour screens. SHA, 1996 (Holl 2006, 193)

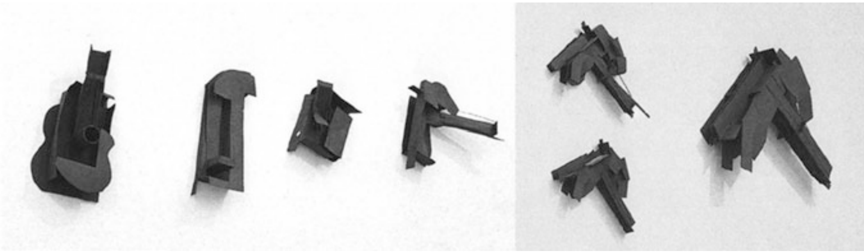


Fig. 10 Series of transformations based on Picasso's sculpture. SHA, 1999 (Holl 2003, 428)

building, a project carried out between 1999 and 2006. Initial studies with models show a sequence of planar constructions whose surfaces are joined together by hinged sections, inspired by the Picasso cubist sculpture *Maquette for Guitar* from 1912 (Fig. 10).

Lastly, the importance of concept diagrams in formalising Steven Holl's architecture should be noted for their power to capture the essence of each project and their role as an engine driving the design process. In conclusion, his work and method have clear pictorial characteristics and qualities, which come directly from his decision to not use computer graphics techniques in the initial design phase of a project.

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Re-drawing Architecture for Exploring the Design. From Research to Teaching and Vice Versa

Roberta Spallone

Abstract Re-draw architectures as heuristic practice aims to explore the motives, the conception, and the formal and technologic choices, understand the relationship with the original and current context, the transformations, from concept to realization and during the life. In the research the practice of re-drawing, is involving the author along with a group of Master's candidates, with the contribution of historical disciplines, on case studies relating to Twentieth century demolished, altered or 'on paper' architectures. In the teaching, a version of this activity, adapted to the students' training in the Laboratory of Drawing and Survey, has been proposed, also with input from some lectures by architectural design professors.

Keywords Drawing and design · Research · Teaching

1 Introduction

> for designing a building you need a wealth of ideas, conceptual structural and formal, which has to be acquired by other architects, ancient and modern (…) And there is no chance to get a 'language system', in architecture, if you do not analyze drawings and photographs of the chosen subject, draw everything, proper trace (…) After all it is a reversed path, than the design (Quaroni [1987] 1995, 17).

Re-drawing architecture is an activity of cognitive, interpretative and creative meaning that have involved, since the last century, scholars, teachers and students of Architecture in Italy.

The manual activity to which Quaroni above refers, offers some advantages, especially from a pedagogical point of view, allowing students to face the scale drawing, assess the level of detail of the different drawings and replay by choosing lines, thickness and graphics, between the standards ones, but also to offer personal interpretations gleaning from different tools and techniques of representation.

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Conversely the digital tools offer the possibility of a more rapid three-dimensional recomposition with respect to the traditional re-drawing, especially when modelling regards the interior and exterior, even allowing, depending on software chosen for the work, to derive the technical design drawings from the sections of the model.

In addition, the digital modelling enables to enter the fourth dimension, allowing original and new explorations of the created models and also to create physical models and prototypes of the object in question. The time dimension may also be useful for simulating different phases of construction and transformative as well as to decompose and recompose the analyzed artefacts.

The digital world offers then, even in this ambit, new and additional possibilities for analysis and interpretation, with the ability to generate synthesis models that collect the information gained and represent them in the form of two-dimensional technical drawings, 3D models, digital animations and prototypes digitally manufactured.

Depending on the different stages of the design under consideration that, in the research described below may range from those that remained on paper, those realized, altered or even demolished, vary the basic materials available to scholars: archival drawings and writings, plastic models, vintage photographs, contemporary reviews, historical surveys, with regard to the initial life of the project, as well as urban/territorial maps and current surveys regarding today conditions of the building and the context in which it stands.

Also the re-drawing intents may be different, oriented also on the available sources: reconstruction can relate to the design drawn, or its different versions, or that built with the different transformations, but also the choice of the time when imagine the reconstruction, can vary depending on the different possible interpretations.

The possibilities above outlined have been personally explored in the research and the teaching and are applied in the case studies below developed.

2 Re-draw to Discover: The Research

In the research the practice of re-drawing is involving the author along with a group of degree candidates, and the contribution of Contemporary Architectural History scholars, on case studies relating to twentieth century architectures, demolished, altered or remaining on paper or on individual analyses of the work of some contemporary masters (Spallone 2015a, b).

Kahn's unbuilt masterworks are the subject of a research involving the author with some bachelor candidates.

Among these, the U.S. Consulate in Luanda (1959–'62) and the full configuration of Salk Institute in San Diego, California (1959–'65), were modelled respectively by Marco Andrea Tancredi and Alessio Alberti.

The design of U.S. Consulate proposes the incorporation of unglazed, independent forms borrowed from the ruins of the ancient world, which Kahn saw during his stay in Rome, into a very modernist architecture.

In the building Kahn addresses the problems of climate by developing two design themes: the ruins wrapped around buildings and the separated roofs for the sun and the rain.

Tancredi chose to display the model, mainly in parallel projections, with the aim to highlight the correspondence between the two buildings, the internal distribution, the structural system and the performance of the vertical diaphragms (the ruins) and horizontal (double roof) with respect to the climatic conditions. The roof plan of the whole shows correspondence in size, alignment and roof perforations to the sun and the rain; cutaways and exploded isometrics show functional partitions and load-bearing supports; the setting of shadows shows the solar behaviour. The application of photorealistic materials and lighting to perspective scenes in which there are also daily life elements offers possible foreseeing of artefacts and spaces designed by Kahn.

The Salk Institute for Biological Studies along the Pacific, in the vision of the founder Jonas Salk, would have to be a place where artists and humanist could inform and inspire those working on the frontiers of science. The architectural complex designed by Kahn included the laboratories, the meeting house and the houses for the fellows, but only the first one was built.

The theme of ruins as devices to control glare appears also here as three-dimensional, complete forms that define and enclose space. Indeed, fully exterior and independent cylindrical ruins wrap around cubic inhabitable space, and cubic ruins wrap around cylindrical inhabited space.

Alberti in his thesis aimed to represent Kahn's project in its context as if it had been entirely built.

The relationship with an environment strongly characterized from the dry rocky slope overlooking the sea, the spatial articulation of the three architectural units and the careful choice of materials, are Kahn's design themes, which inform the choices of representing the model of the complex inserted in the environment as if it was a plastic model. The terrain has been shaped by extrusion of the contour lines giving the environment a degree of abstraction comparable to that of the artefacts. Even the colour attributed to all the natural elements through the application of a material that evokes the cork allows distinguishing them from the buildings clay rendered.

The final product of the representation is a 7 min video, which allows to dynamically exploring the three units thanks to fly and walk through. Only a few still images in photo-realistic rendering with fast fading effect can evoke a perceptual effect generated by materials and real lights.

Another study carried out by the author and Bruno Jr., concerns the utilization of digital techniques of representation to adopt new strategies for the preservation of the architectural heritage and its memory (Spallone and Bruno Jr. 2013). The experience, conducted with some bachelor candidates, regards the application of computer technology for the virtual reconstruction of some minor architectures realized in Turin during the Thirties on charge of the Fascist Party, today deliberately lost due to their symbolic means. The reconstructive operations start with a precise analysis of the graphic documentation stored in archives, a research of the original pictures and a survey on the building materials utilized at that time. After this first step of data collection, the digital reconstructive process begins, regarding the building itself and the surrounding context. The interaction among different scientific disciplines, such as history of architecture, representation and also material technology will guarantee the experiment a higher scientific level.

One of the case studies analyzed, the Casa del Marinaretto, built in the Thirties and demolished without any consideration in the early sixties shows such original and interesting design solutions, that the preservation of its authentic memory and its valorisation seem justified.

The Casa del Marinaretto was designed by Costantino Costantini close to the river Po, looking like a big ‘urban anchored ship’ of huge impact. In the sixties has been demolished to permit the building of some not valued architectures, cancelling the memory of a high quality architectural product with international inspiration. The work moves after the rigorous analysis of the original drawings preserved in the Turin archive and proposes the reconstruction of this building according to its original version as it was drawn by the architect for the first time, and so in a different manner respect to the built result. This process guarantees also the 3D perception, the authenticity of the materials and of the location into the urban context, using digital static and dynamic rendering systems. The 3D model of Costantini’s project, inserted into the urban and natural context of our days, to simulate the perceptive effects that the building could express today if it was still standing, was made by Francesco Carota.

The model, realized using 3D computer graphics and animations programs, is the basis for the production of a video-clip that explores the relationship between the actual image of Turin and the Casa del Marinaretto and describes, with the synthetic language of the movie technique, the original shapes and the emotional reactions, the same as it was real.

Another line of research concerns several buildings of Carlo Mollino, whose archive of drawings is preserved in the library of Architecture at the Politecnico di Torino, and characterizes a series of theses, conducted in collaboration with Sergio Pace. The subjects, until now studied are the Turin Horse-Racing Society Building, demolished in 1960, two ‘ideal houses’ respectively published on the magazines Domus (1942), and Stile (1944), and the competition design for the Palazzo del Lavoro in Turin (1960), unrealized because not winning.

The Horse-Racing, an early and acclaimed work by Mollino was short-lived (from 1937 to 1960). Its demolition was connected with the wider process of urban transformation, which involved the area along the west bank of the river Po, triggered by the celebration of the Unification centenary of Italy.

The digital reconstruction of the building has been realized by Florida Canaj during her master thesis.

She also analyzed the relationships between the building and the context, less dense than the current, but strongly characterized by different buildings, reconstructed by means of archival city maps and design drawings.

The Horse-Racing has been reconstructed in detail, once identified those archive drawings that allowed the most faithful reproduction of reality, after filling in the missing information and resolving ambiguities and inconsistencies of the documents. In this sense, the re-drawing of the project takes on the meaning of a true re-design that requires a deep understanding of the artefact and poetics of the architect.

The modelling phase has been carried out by the technique of 'blueprint', arranging plans and elevations on orthogonal planes so as to foster the most appropriate control of the process.

The model has been lightened with sunlight while, about the materials, the opaque surfaces are rendered using clay and those transparent with glass. In this way the model maintains the proper level of abstraction and avoids generating the sense of fake that characterizes the photorealistic reconstructions. The choice to represent the perspective views of the model in black and white goes to the same aim, allowing also a comparison with the vintage photographs taken under the guidance of the same Mollino.

Further processing, which aims to compare the digital model renderings with the original photomontages, and to search the same view points and solar illumination conditions, has been lead to try a new photomontage of the model in the portrayed old context.

The Casa sulla collina (1943) and Casa sull'altura (1944) are two ideal houses by Carlo Mollino, digitally reconstructed by the master candidate Antonio Laudani.

The issue of 'ideal houses' animated the Italian architectural debate, during the period of forced inactivity due to the II World War, so that several architectural magazines became promoters of the initiative to request and publish projects of the contemporary top architects on this subject.

In both case studies, the publication of drawings was accompanied by Mollino's writings to the editors, which described the concept, his reasons and widens the speech stating his position with respect to contemporary architectural debate.

Carlo Mollino was an architect who combined the research of architectural quality to a strong knowledge and experience of building (Pace 2006, 120), because he had worked, from the beginning and for about twenty years, with his father Eugenio, an engineer, particularly productive especially in Turin area.

The relationship between the drawing and the constructive reality emerges also in Mollino's designs programmatically intended to remain on paper, of which also the technological details in large scale are graphically defined, the interior furnishings are designed as an integral part of the architecture and, even, the static schemes of some structural elements are traced.

The particularity of Mollino's modus operandi, which was expressed, for each project, through hundreds of drawings, led me to propose the student to use a parametric three-dimensional modeller like BIM, aimed to the three-dimensional reconstruction, in order to assess the three-dimensional consistency of the two-dimensional archival drawings, checking possible variants and obtaining sections from the 3D model, provided with the graphic standards of architectural technical drawing and settable at different scales, selected also in order to compare them to the sources.

The reconstruction was completed by a video and a plastic model digitally fabricated: a demountable material model, made with a small 3D printer which extrudes fibres of polylactic acid.

Through these operations, for the first time, the design is freed from the two-dimensional support, through the transformation in three-dimensional digital model (though always accessible through the two-dimensional space of the screen), achieves the fourth dimension by the production of the video that allows to visit, offering new views, and finally truth imbued in a three-dimensional material object.

In addition, through some Mollino's drawings, which place the Casa in collina in relationship to the centre of Turin, it was possible to hypothesize its location, imagined by the architect on Monte dei Cappuccini, near the XVII century church. The photo-montage of 3D model in the current environment highlights a shocking antagonistic relationship between the house and the church for the conquest of the hill-top.

An additional and different direction took the research that led Giulia Bertola, a bachelor candidate with undeniable artistic sensibility, who, starting from the personal interpretative drawings, realized with different techniques, of architects and designers such as Ettore Sottsass, Gaetano Pesce, Massimo Scolari, Alessandro Mendini, chose to dwell her analysis not on the 'visible' elements, but on the 'hidden' elements, linked to the thought of each designer by analyzing what conducts the architect to make use of different techniques to express his own 'idea'.

The occasion on which her hypothesis were tested was offered by an architectural competition, the IBA 84 for Berlin, meeting place of three masters as Aldo Rossi, Peter Eisenman and Rem Koolhaas, with their different poetics and design approaches. For exploring their proposals, Bertola has dept studied writings and drawings of the three, constantly accompanying her discoveries with drawings, collages and notes on her cahier and arriving to a synthetic graphic work which interprets the competition proposals for IBA.

3 Re-draw to Learn: The Teaching

In teaching, a version of the re-drawing is proposed, adapted to the students' training in the Laboratory of Drawing and Survey in the first year of Architecture at Politecnico di Torino.

The work is conducted on realized works of contemporary masters, starting from the published projects and leads to an exploration of the architects' poetics, through the reading of his writings, the consultation of critic texts on their work, the navigation in their website and then deepen the knowledge of an assigned design through analysis of the context in which it is placed, conducted with the traditional cartography and web map services, and the comparison between the iconographic material found to better understand the distributive, the technological and the materials choices.

The analyses lead to the production of two plates containing 2D and 3D drawings which synthesize the knowledge phase and a short animation and flow into the first practice of the Atelier of Composition and Urban planning, with the production of a plastic model of the building.

Afterwards the scientific assumptions and the educational consequences of these activities are documented.

The exercise of re-drawing is offered to students whose previous training in the secondary schools not necessarily involves the learning of architectural drawing and tools of computer graphics representation into their curricula. The teaching of architectural drawing standards, starting from the representation methods, and in particular of the orthographic projections in their technical form applied to architecture, and the specific graphic symbols are therefore preparatory to such activities. The setting of proper and efficient systems of CAD drawing and modelling, including render, animation and post-production procedures, becomes also necessary, through the application of specific software.

Re-drawing a project using as sources the materials published in magazines and books makes to face with representations, mostly redrawn for the editorial homogeneity needs, generally incomplete and responsive to the graphic standards other than those used in professional practice, while images abound. In contemporary publications, the general trend, in fact, is to reduce the number of drawings and their scale, often not indicated, and to apply a graphic minimalism over the use of conventional symbols, which often makes rather laborious the drawings comprehension, the interpretation of the missing parts and the three-dimensional reconstruction of the building. In return renderings and photographs, sometimes indistinguishable one from each other, increase, while the autograph drawings, illustrative of the concept, are often absent.

Even the contextualization of the object through site plan, that explains the environmental integration and formal choices, only sometimes is published and must be sought through other instruments, such as web map services.

After the assignation of a specific project, the students are invited to construct their own path of discovery of the artefact that involves the reading the architect's writings, literary criticism and journalism, his personal website. They are also encouraged to conduct virtual explorations through visualizations in aerial and street view mode and collect photographs and videos available on the web.

The buildings chosen by the teacher have in common to be single-family houses built in the Western world from the modern movement to date, and they are published as objects worthy of note, with the recognition of contemporary criticism.

During setting of work the teachers of Architectural Design, that follow the same students in the next Design Studio, are invited to offer their personal analyses about some of the relevant projects, according to their specific disciplinary perspective.

The proposed work is conducted in small groups of two or three persons with the purpose of teaching students a conscious division of work and sharing responsibility: each student must be able to respond to the teacher's observations about the group work.

The drawings are composed in two plates of A1 format with a layout provided by the teacher.

The re-drawing consists of a real transcription, with a high content of abstraction: the process starts from the recognition of each sign, as part of the built that has a three-dimensional and material consistency, and arrives to another type of sign, which responds to the codified language of the architectural drawing. Each line in the iconographic sources must therefore be read, recognized, interpreted and then traced.

The representation of the materials in the two-dimensional drawing of elevations involves the individual research of those iconic graphics that evoke particular textures realized, making unusable the hatches offered by the software.

The integration between the different sources—drawings of plants, elevations, sections, axonometry and perspectives, with photographs, renderings, videos– facilitates the understanding not only the shapes and materials, but also the paths and ways of use of the spaces. It is a time of great educational value, generally for the first time; the student has to recompose and synthesize information of different nature, facing to the representation of his cognitive path regarding architecture and its environment.

Interesting considerations may arise from the comparison between the original context, documented by vintage photographs, and the current one, that students are asked to represent. The older architectures, in fact, seem sometimes to have drawn some of the reasons for their conformation to environmental conditions no longer present as a result of the urban and infrastructural development. Even the projects themselves may have been subject to changes, or when running or after. All these variants must be carefully recorded by students, and compared with the present situation.

Once made the two-dimensional representation, through a site plan in scale 1:500, plans, elevations and sections, in scale 1:100, i.e. the scale of the final project drawing, the three-dimensional geometric modelling, including interiors, always using CAD tools, is proposed. As known, there are no coded standards about the relationship between scale and content of the 3D model that tends to simplify the object using geometric primitives, because the complexity of the work. Furthermore, the possibility of generating animations, with move to and away from the object, makes the choice particularly delicate. In the actual practice, modelling the building including openings, balconies, roofs, interior walls, stairs and any other distinguishing features, is required. The terrain is created by solid modelling starting from the contour lines; the surrounding buildings are reduced to geometric primitives while the trees require special attention. In order to make lighter the files, the real trees are contoured and slightly extruded and then copied and rotated 90° so as to allow a three-dimensional display. Isometric views, bird and human's eye perspective of this model, displayed in hidden line as the traditional technical drawings, are set. Generic materials are then applied: clay for all the opaque surfaces and glass for the transparent ones, setting the different lighting conditions, from solar light through which solar studies on the site plan during the solstices, to the artificial ones generating night views.

The choice to represent only the opacity and transparency, avoiding the application of materials and patterns offered by the software, responds to the teacher's will to make appreciating the geometric and spatial qualities, and lighting effects of the modelled buildings, keeping them deliberately in a conceptual sphere flatly distinguishable from real buildings.

The model is also presented in exploded and cutaways views that accentuate the conceptual meaning. Particular attention is paid to the comparison between the photographs of the building and rendering made through research of the same shots.

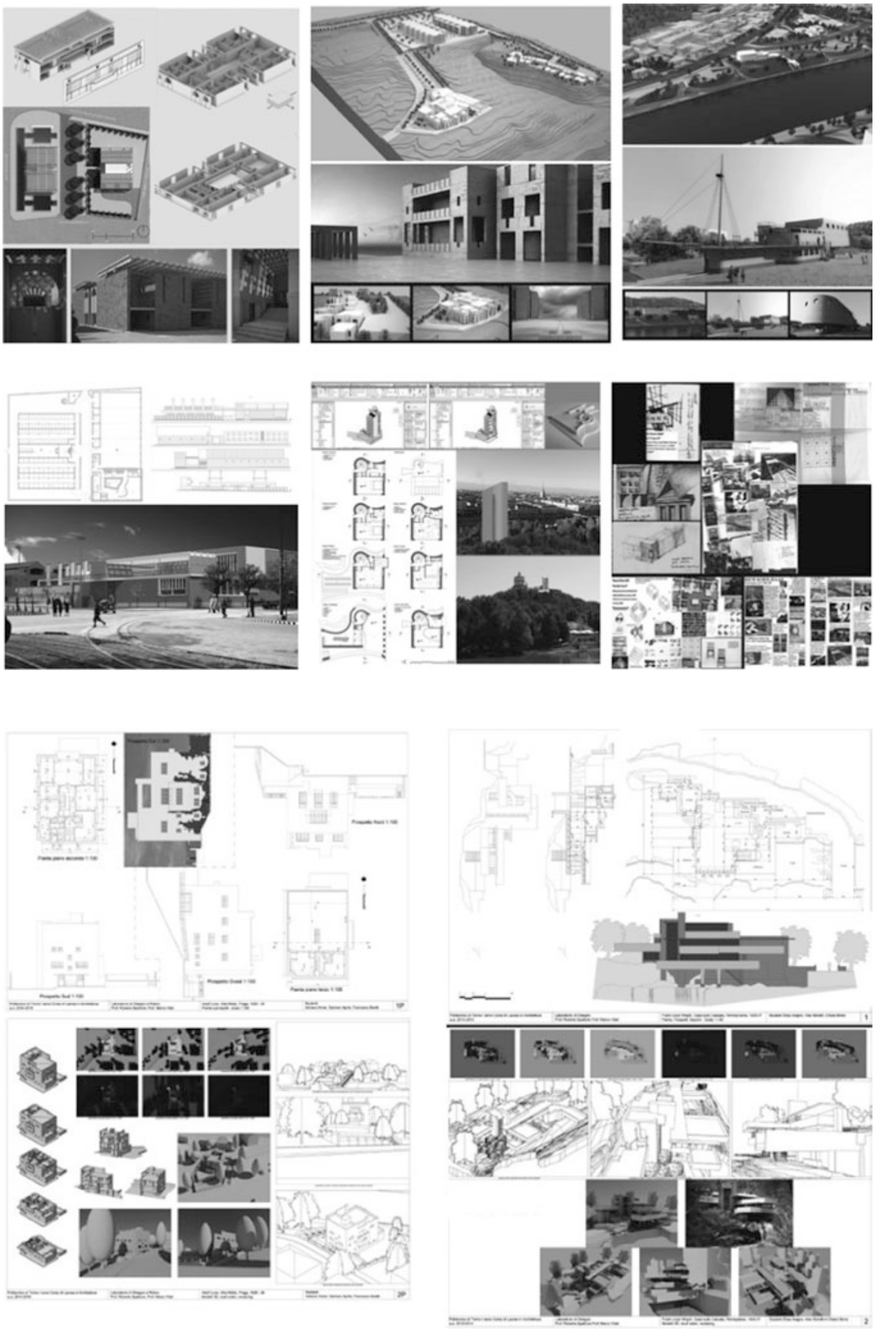
A short animation, constituted by a path around and inside the building, finally allows simulating a virtual tour of the building, verifying the perceptive effects.

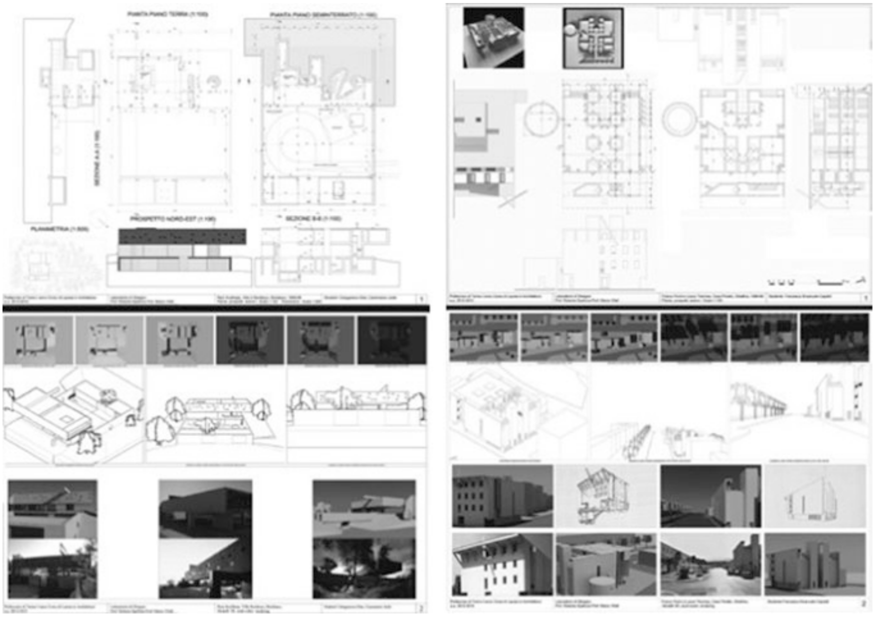
The plastic model, which constitutes the first practice of the Design Studio, ideally ends the cognitive experience with a material object, generally realized in sheets of poly-plat, an easily workable material that allows the construction of a non-mimetic, openable and decomposable plastic.

4 Conclusions

In the considerations and case studies above developed two different approaches emerge about the re-drawing of the design intended as a heuristic practice.

In the teaching, in fact, the knowledge moment is privileged and the use of representation tools, strongly conformed, is aimed to the acquisition of the architectural drawing conventional language and to its use for expressing the cognitive process accomplished, in the research the interpretive moment prevails, in particular based on deep analysis of the masters' poetics taken into account, and on the putting in relation the texts and drawings. The choice of the adapt tools to express these interpretations then becomes part of the interpretation itself: it cannot be unique and draws from the sensibilities of the one who has to re-draw, that performs an operation of real re-design with his work.





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Atlas and Graphic Discourse. 50 Years of Strategies. Interactive Map

Alberto Grijalba Bengoetxea and Carolina Heisig Carretero

Abstract Nowadays a qualitative leap is found in graphic production, a graphic discourse which is encouraged by new technologies and reproduction systems. There is a change in the *visual grammars* and we find a hyperinflation of the spreading of the new proposals in the new Information society. We pretend to analyze the drawing as a graphic language and as an effective mean of architecture expression, in a period of 50 years, when different graphic production strategies have been used. The documentary research, identification and cataloguing of the graphical material follow the production of an *Atlas*, an interactive map space-time is a result.

Keywords Atlas and graphic discourse · 50 Years of strategies · Interactive map

1 Status of the Issue

Once advanced XXI century, over the equator of the second decade, the question around a *metanarrative* about the History of Modern Architecture drawing, is still pending. This story is incomplete, we find it broken and disperse, probably due to two simultaneous factors. The first one is related to the capability to put data in order, its analysis and read, attending to visual culture and current graphic discourse, parallelly to how shown by information technologies, the so known Big Data.

The second of the factors is the inexistence of a History of the XXth century drawing, probably due to the impossibility of putting together a unitary story about drawing according to the *great story* of the rise of the Modern Movement, as pointed out by professor Carlos Montes. Great story understood as the polyhedrically

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simplified interpretation of a complex reality, somehow idealised, but comprehensible by generality, as defined Lyotard.

The complexity of treating the Information, together with the disbelief of *metanarratives* in a postmodern world, is the starting points of this investigation. A starting point that is contradictory with the current need of studies about the old Great Narratives as the diverse or new architecture standards, the gathering in research works and diffusion of its conclusions in publications such as: *100 Years of architectural drawing* or *1001 paintings you must see.*

Indeed, the contradiction is patent, we currently find a qualitative gap in graphic production. A *graphic discourse* that helped by new technologies and new reproduction systems finds itself in a constant development and evolution. At the same time that this change in the *visual grammar* (Marchán 1990) occurs, we find a hyperinflation of the diffusion of new proposals. At the same time our ways of interpreting and knowing reality is changing. On one side, nowadays we have the possibility to find any information or knowledge due to its diffusion both in paper and virtual publications. Never was this much knowledge within the reach of so many. But on the other, facing the reality of the vast aspect of knowledge, we need an analytic and ordering system that simplifies it. A document that allows us to quickly access information, places and locates it, attending to certain categories that allows us to create an essential map of its relations. Definitely, *Atlas*.

The same as at the beginning of the 21st century, Arntz's Isotypes and Pictograms, elaborated for Neurath, proved to be an effective mechanism to share knowledge. Jacques Bertin established from the sixties the Graphic Semiology in order to explain the territory. It is not only about a graphic representation but most of the times it implied for him a strong responsibility on what and how to do. A visualization between the quantitative and qualitative (Bertin 1973).

After these first experiences, Richard S. Wurman will be the one to code the Information presentation systems under the name of Information Architecture, IA. It is at this point that we find the information is a group of images and texts categorised around the principle of: Location, Alphabet, Time, Category and Hierarchy LATCH.

There were many attempts to generate a map of Architecture in the 20th century. Some tend to be similar to the famous London Metro map by Beck in 1933, where the most important are relations, crosses and colours. Others, like the ones from CH. Jenks, are multiform masses that relate architects, tendencies and data, placed in a strict temporal frame, but where only names and texts are referenced. The diagram from Professor Capitel about Spanish Architecture on the last third of the 20th century, published in *Summa Artis* vol. XL, discards time, placing the diverse architects depending on hierarchy and the proposed categories (Fig. 1). At last, Italo Roca in his "Hundred years of Italian Architecture" published in Domus no 764, from 1979 draws the tree of Architecture that emerges poetically over history's natural soil. From the branches, depending on its position and size, leaves with names of architects are born, which are shaded by small suspended decorations where the unclassified place their singularity (Fig. 2).

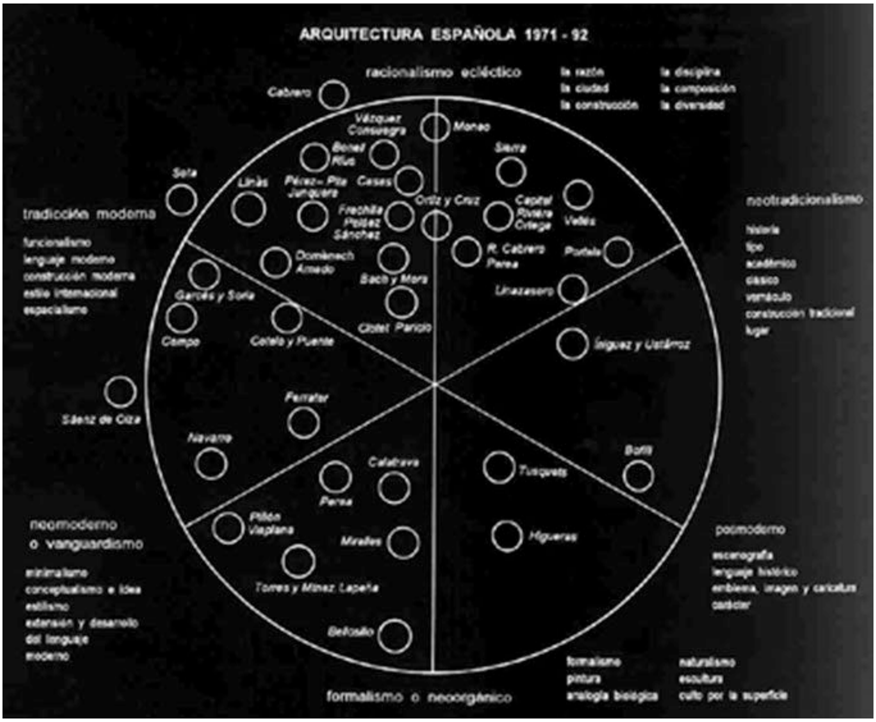

Fig. 1 Capitel, Antón. Arquitectura Española 1971–92. Summa Artis, vol. XL. 1995

All of them are an attempt to explain the complex in a simple way, to understand, paraphrasing Albert Einstein.

2 Context

The time frame, in which it is pursued to realize this analysis of the drawing as graphic language and effective means of expressing architecture, focalises in the second half of the 20th century. This period is subsequent to the Modern age of the first half of the century, where diverse graphic production strategies have been used.

The context in which this work and investigation are placed has a very clear beginning with the CIAM that has place in Dubrovnik (1956), where the TEAM X is built and an also outstanding end with the 10th International Architecture Biennale in Venice (2006), where international architects such as Norman Foster, Zaha Hadid, Richard Rogers, etc. concur under the title: “Cities: People, Society, Architecture”.

This time frame has been chosen because it results interesting to observe the gap produced in the Architecture of the 50s; how the second half of 20th century started

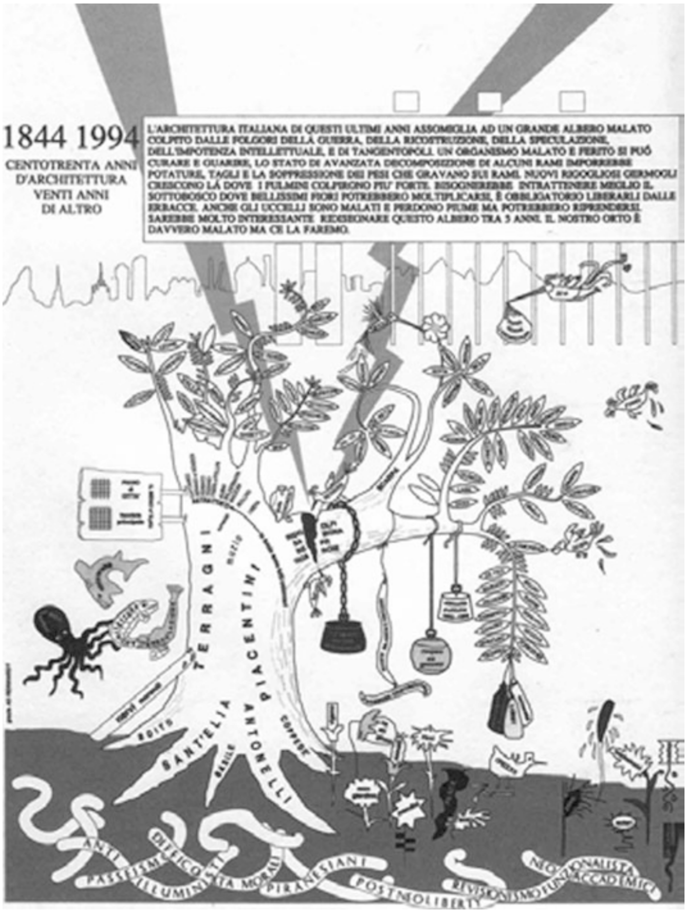

Fig. 2 Roca, Italo. Centrotrenta anni d'Architettura. Venti anni di altro. Domus Magazine, 764, 1979

with a clear predominance of the Modern Movement but with the years, and especially from the 60s, its bases started to be questioned. It is like that that the great diversity of proposals of all sorts of styles appears, which makes of the chosen time one of great interest for analyzing the different movements, giving as a result an exhaustive and rich documental search with its ulterior cataloguing, analyse and comparison. The architectonic panorama referring to the graphic discourse finds its way through the use of diverse formulas, the management of a more complex and sophisticated technology, getting to the use of informatics as the key tool, showing a special interest for the problems on the fields of urbanism, sociology and economy.

In that sense, it is key to start the period with Dubrovnik's CIAM, where categories as mobility, cluster, growth and change, urbanism and habitat are proposed. The CIAM (*Congres Internationaux d'Architecture Moderne)* were a very important piece on the development of 20th century Architecture (1928–1956) and on the theory and practice of urbanism. The Modern Movement appeared as a result of 19th century rationalism and the need of a social development, making architects' worry about style move onto themes such as method, organisation and technology.

The dissolution of the CIAM 10 was obvious when the high number of members, over three thousand, made the discussion about any topic complicated, generalist and diffuse. It was then that the TEAM X was left in charge. From that moment the evolution of the graphic discourse goes through different architectonic movements and varied architecture figures that bring us close to that big diversity characteristic from this period. We have analysed those movements which characteristics and renewing ideas make the comparison between them the key to understand this varied period. From the new Brutalism to Ecologism we have selected the Team X, the Metabolists, Archigram, Archizoom, Superstudio, High-tech, Postmodernity and Deconstructivism. Special attention has been put on architects, not considered inside any movement for its importance in the development of the Architecture of the second half of 20th century. Not only references to architecture are made, but to understand it in its complexity there must be other arts, being necessary to include other disciplines as painting, sculpture, cinema and music, and also renowned expositions and competitions that give as a result a wide comparative spectrum.

The end of the period coincides with the X International Architecture Venice Biennale (2006), Biennale that for the first time welcomes the problem of urban development and its planning, continuing with the worry for urbanism that, as we advanced before, occupied the architects of the 20th century. The topic "Cities: People, society, architecture" focused the development of this Biennale in urban planning from the social dimension of the city, the relation between architecture and society. This makes inevitable to compare with the chosen date for the beginning of the period, the CIAM from Dubrovnik and the architects of the TEAM X. Like this, beginning and end of this time frame are chosen because of their 50 years difference (1956–2006) and because of its similarities on reflecting similar worries related to architecture and urbanism, by the outstanding figures on those moments.

3 Methodology

The development of the investigation comes from a documental search, a Big Data that enters a process of acknowledging and cataloguing on a first phase. A series of examples are chosen during that period as graphic material for an ulterior analysis, whose final objective is the making of an *Atlas*: an interactive map of space-time.

It is important to emphasize that the gathered documentation in a first place needs to be filtered and evaluated, because what interests us is to process it to make it into a graphic representation that contributes with that big amount of information from the direct visualization.

The graphic representation of the information in subjects as varied as technology, economy or business, has been always present, and finds itself in constant development and evolution. In the last decades the graphic discourse has gathered even more strength, cheered by the new advances in reproduction systems and by the new technologies that contribute to a new reading of information in the digital era, where the use of new gadgets influence in a very visual manner in our way of receiving data and communicating.

A previous approach to the topic consists in a search of examples of maps related to architecture and arts through time. Inside the frame of architecture we fi various examples of Charles Jencks. In the genealogical tree that is shown in the image, the author analyzes during a period of twenty years different architecture movements along where he places different tags with names of architects and architectural pieces of work. It is interesting to observe the disposition of the information in relation to the time location, the category and the hierarchy. Depending on the importance the tags appear bigger and depending on the concepts being related they are close to each other. However, this example is done only with keywords and names, without the inclusion of images that transmit the information on a more direct and visual way. Also, the movements that the author identifi correspond to lines of different thickness and mass along an axe, but they don't mix and no comparison or bond is established between them (Fig. 3).

The next example includes one of the aspects relative to the visualization by diagrams and images that focus on a very effective way on what they want to transmit. It is the case of the Production of the Architecture Publications of OMA/AMO. Along a chronologic axe, images of diverse magazines and media are placed, supported by extra information on the bottom of each column. Occasionally comic balloons appear and the most important events are underlined as an explosion. Under the apparent chaos a magnificent order is hidden, where studio publications are stacked in growing order through time (Fig. 4).

The example of map configured by the MoMA (Museum of Modern Art of Nueva York) has a fresher approach and reading, because of its interactive character. Names of artists show up in different colors depending on their relevance, and once you zoom over them you can observe the relations with other authors, and a technical file opens with information about their lives and work. The map itself does not contain images, but names of the artists. It is once you get deeper in a particular author when you can know more in particular about that character. This map adds a fundamental component towards the configuration of our own map, the interactive part. The visual process that accompanies the discovering of new knowledge doesn't make part of an static printed map anymore, but has changed to be dynamic in an online connection system, with access across the globe.

Through these examples we analyze the aspects to consider in order to configure the new *Atlas*. It is important that the great amount of documentation with which we count at first becomes in quality of information, which means that the Big Data is contained and compressed in a graphic representation that incorporates not only

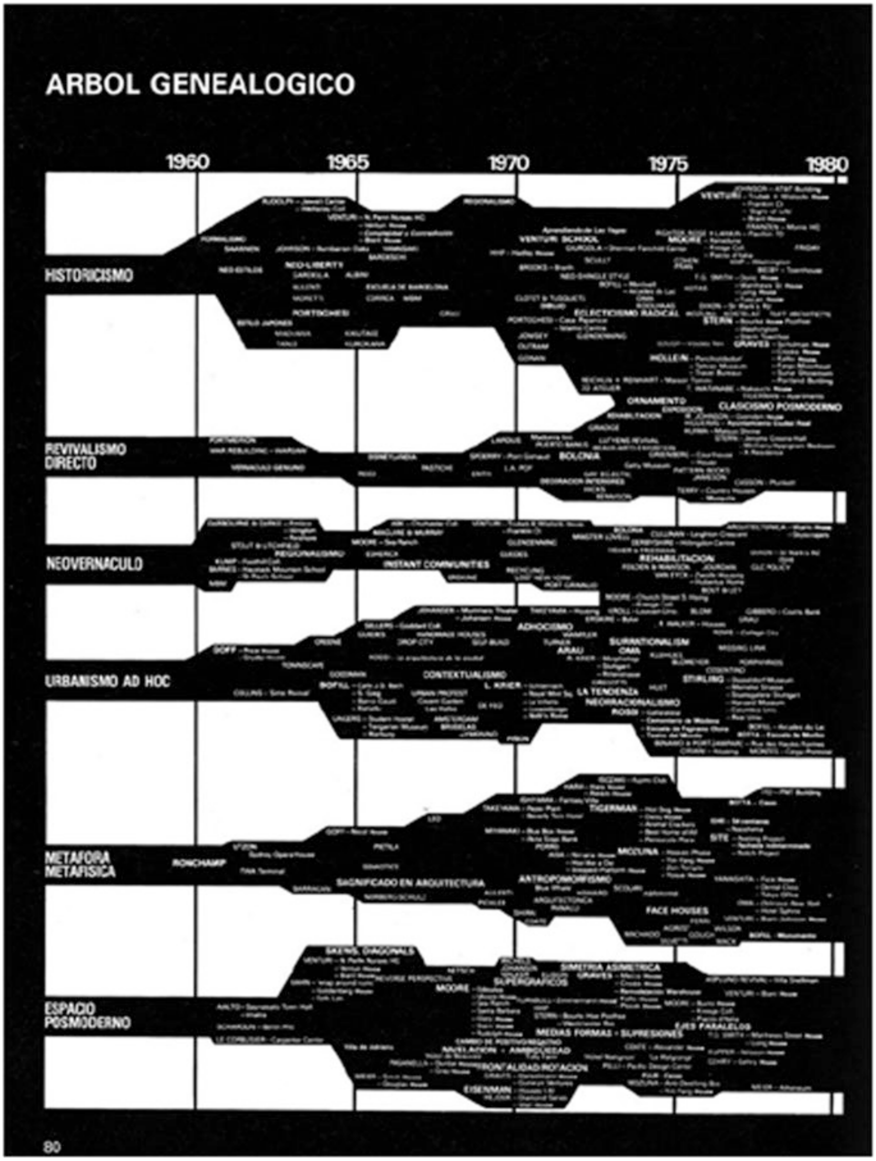

Fig. 3 Jencks, Charles. Genealogic tree. 1980

tags but images and connections between the parts. At the same time, it must facilitate the increase of information zooming at some particular parts or at the same time allow that different windows of information are included inside the document (Fig. 5).

Fig. 4 Grau, Urtzi and López-Pérez, Daniel. Architecture Publications of OMA/AMO. 2007

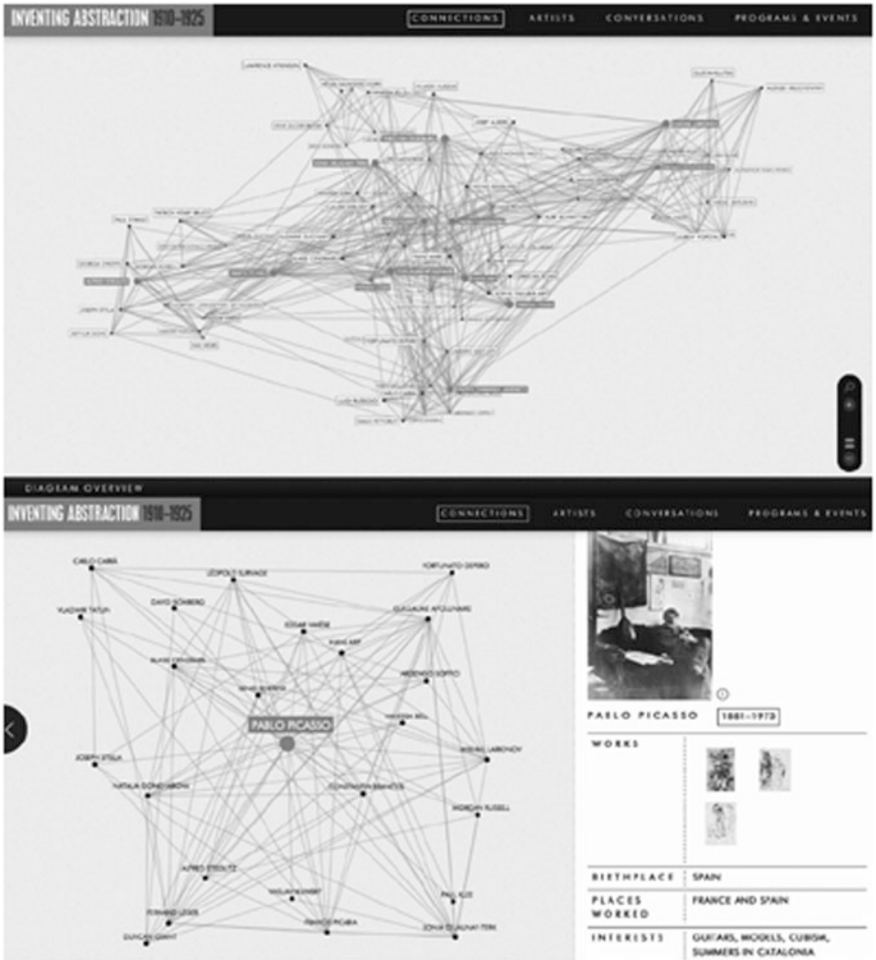

Fig. 5 Dickerman, Leah and Chlenova, Masha. Exposition inventing abstraction: 1910–1925, MoMA, 2013. Interactive virtual map, general connexions and example of particular links from Pablo Picasso (www.moma.org)

In this interactive space-time map affinities and differences along the time can be compared or in their more formal aspect, plastic and graphic. The fields of study that are presented are connected by itineraries and categories depending on the established hierarchy: 100 architects, 10 architectonic movements, 50 pieces of art, 10 artistic movements, expositions, etc. As part of the interactive process, its itineraries can activate or be turned off and like that, appreciate the impact or relation depending on the needs of search or study. Each category is composed by files with information related to the piece of work, architect or exhibition, and its codification referring to the ideas of the movement in which it is included.

For the configuration of the *Atlas*, understood as compendium and complex addition of diverse maps, we have started by the disposition of the information in a written and physical way by tags. Following the process, once reunited the images referring to the chosen graphical examples, we have configured a digital map and at last, the dynamic component has been introduced to help a better understanding of the existing relations between the diverse movements, architects, works … the communication focalises the texts in combination with images, and movement diagrams (Fig. 6).

It is elemental to mention that this interactive character is open that means, it can still be configured and new fields, tags, images connections, etc. can be added. Also, not only can it be considered as a unique Graphic Representation, but due to the itineraries and layers that can be activated or turned off, various maps can be created depending on the characteristics that need to be compared or the interest of the study.

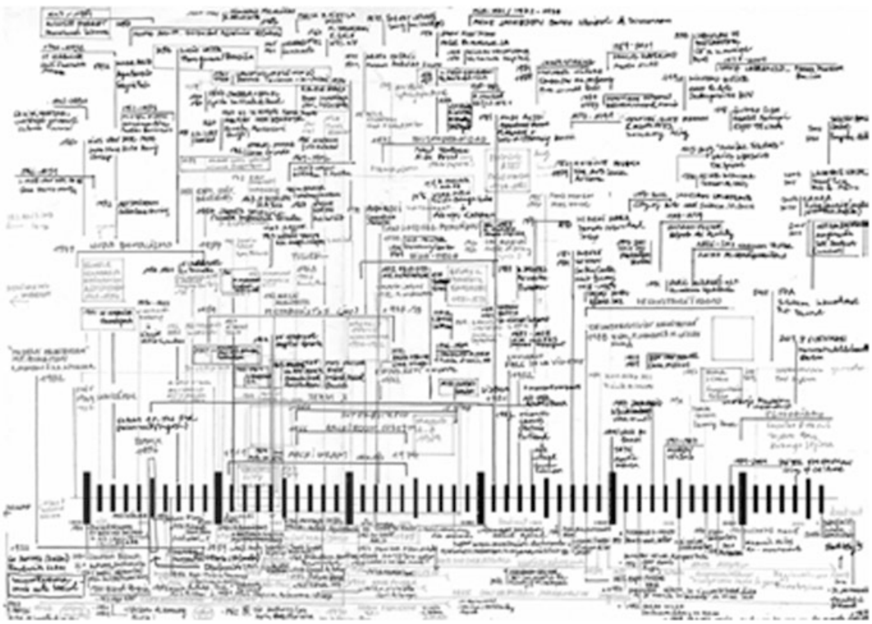

Fig. 6 Holographic work map. 2014

4 Result. Comparative Atlas

With *Atlas* we try to achieve an actual look to the graphic discourse, giving the knowledge from an interactive tool that allows to make a comparative and temporary study. *Atlas* as addition of diverse partial knowledge maps, which in its continuity interpret a reality. The final objective is the creation of a tool that allows us to make a comparative study through the exemplification of architects and works, from which we will obtain conclusions (Fig. 7).

When comparing the informative graphics or the text diagrams the result is surprisingly effective. The facts are presented in order and the connexions are easy to understand. In the digital era we communicate more and more often with links; blocks of text combined with graphics, photographs and diagrams to create a story or give an explanation. The informative graphics and the visualization of the information are becoming needed tools to explore our world (Rendgen 2014).

The visual images help to bring information closer, making it more accessible. From centuries ago and in various fields of learning, the visual objectives have been used to establish relations and connections that were more difficult to transmit only with words.

Converting the great information that we face at the beginning in an elaborated Atlas that contains all the data is a fundamental objective to transmit in a simple way the biggest quantity of documentation possible, in the period framed by the research. The great impact and continuous development of the digital era in our lives make it a need to diffuse contents in a very visual and actual way not only through text.

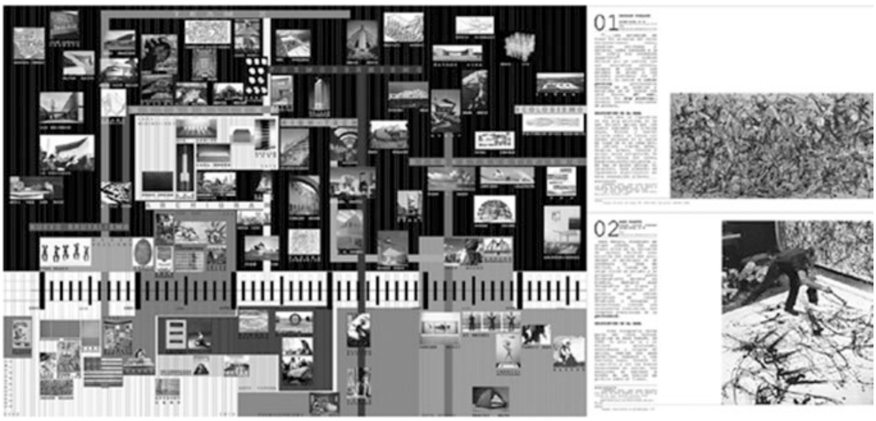

Fig. 7 Proposed map for the research in development. Example of files of two pieces of art. 2015

5 Conclusion

Probably working on an Atlas about the graphic discourse is a conclusion itself. The process of work, the proposals, the analysis, the choice of the documents and its transformation from the first holographic sketches to a digital application was as a result. In the first place for the subjective, despite the trial for aseptic objectivity with which the process has been taken. From every choice a positioning is taken towards the history of Drawing of the last five decades.

Secondly, the treatment of visual information has become an objective, trying to clarify and analyze the contents, being aware of hierarchy, association and position of the elements, in order to give the most possible information with just a glimpse. It is not then a document with which only compositional-graphical excellence wants to be achieved, implicit in our area, but that at the same time results effective as a narrative of the knowledge in a graphic discourse.

Thirdly, is the extensive of the work itself. It is true that from the beginning the work has been limited to a 100 architects, 10 architectonic movements, 50 pieces of art and 10 artistic movements. But, despite the need of that limitation, obvious necessity in any investigation work, it has proved to be in some cases partial and exiguous. One of the first conclusions taken into count in the process was the possibility of growth of the *Atlas* or not making a work that was closed in the future. The graphic model of representation has been varied depending on the possibility to complete the document. But this new information to be defined must be treated from the beginning relying on its size-position attending to the three means of catalogation: time, categories or movements and hierarchy. More graphic documentation does not necessarily mean more transmission of knowledge or more clarity, as we have learnt through the Process.

In the fourth and last place: the density of the information. This Atlas of Architecture does not pretend to reduce the knowledge to an image on relation to a position, trivialising its content. It is not a reducing sketch, which pretends to be a superficial analysis that reduces knowledge. We tried to avoid the common dysfunction of the Theory of Big Data Communication: fast read but little knowledge. With its interactive capacity, where it is possible to modify the mechanisms of search and amplify the information with emerging windows of complementary documentation, it is not only a map to orientate but an Atlas of knowledge, aggregation of so many maps as we will be able to elaborate.

Same as the very interesting Map of the first director of the MoMa, Alfred H. Barr *Cubism and Abstract Art* 1936, that has been completed by the Museum in 2013 in the Exposition Inventing Abstraction 1910–1025, with an interactive and dynamic model completed with personalised files of movements and artists, the result of the Atlas of the Graphic Discourse is a clear, interactive and simultaneous model.

Simultaneity is finally the last contribution. The work in several windows at the same time, even with several registers, is one of the characteristics that allow the new technologies. To see the general Map, at the same time as we point up a

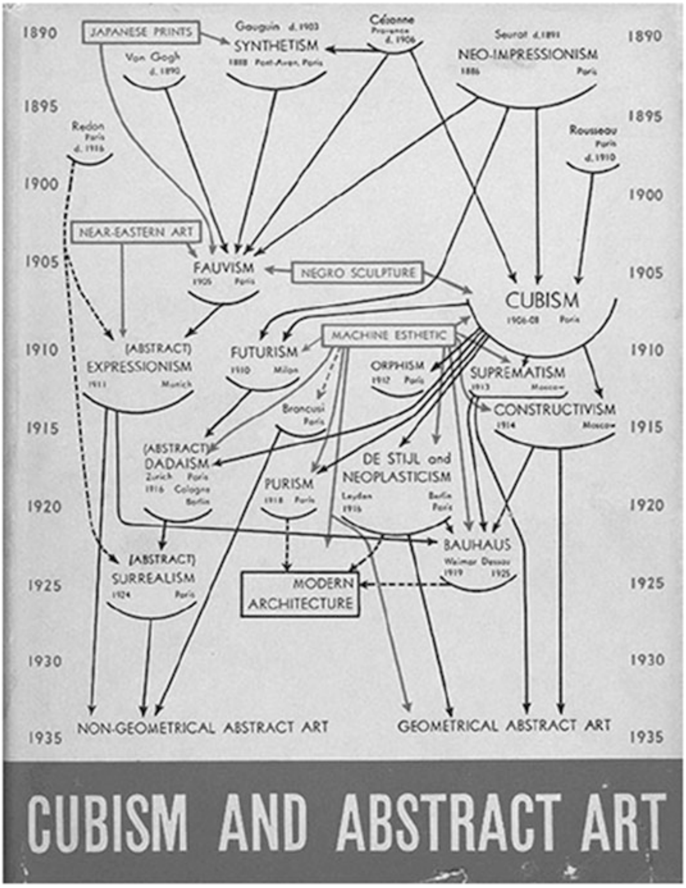

Fig. 8 Barr Alfred H. Exposition cubism and abstract art. 1936. MoMa, April–March 1936

particular line of affinities while it is possible to open emerging windows about an author, work or architectural movement. It is a tool as flexible and dense of knowledge as the user needs (Fig. 8).

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Generative Education: Thinking by Modeling/Modeling by Thinking

Fabio Bianconi and Marco Filippucci

Abstract Generative models change our way to think of architecture. We have tried to show to our students this changing of digital tools' conceptualization, not only as a simplex extension of hand but rather a complex link between aesthetic and technique. The presented experience is part of the academic courses of "Drawing" and "Techniques of representation" held in the Faculty of Engineering of the University of Perugia (Italy). The aim was to challenge traditional paradigms: we have proposed to analyze ordinary objects, or groups of similar elements, and think by using models, with an holistic approach. We wanted to teach that an architectural project isn't a particular artifact, but rather an idea structured by complex relations between parts and by certain transformations of parameters. We believe that if a designer understands that a common reality is so organized, he'll be able to design architecture with the same approach. One of the most important concepts is that a variation of a parameter doesn't destroy the model but only changes its aspect. Moreover, our capacity of pre-vision by drawing usually can't explain every possibility. But by thinking in a "modeling way", as Gaspar Monge pointed out in his descriptive geometry books, it is possible to go from "known to unknown". Therefore the generative modeling is useful to understand the form and its morphogenesis, and in such-a-created model is possible find a tool of creativity and a source of inspiration. In particular, through the use of a generative software like Grasshopper for Rhinoceros, the results were models able to create different types of flowers, pastas, cheeses, pencils, marshmallows and so on, each category corresponding to just one algorithm. Afterward, we have explained that certain concepts of descriptive geometry could also be explained by generative modeling, showing a unitary morphogenesis of complex shapes and its application in descriptive geometry theorems. So we asked to think of architecture in such a way,

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with the result of a new vision of the project, like dynamic transformations of the shape of buildings, bridges, pavilions and so on. Variations of certain parameters that generate a renewed capacity of the architectural model.

Keywords Generative model · Complex surface · Techniques of representation education

1 Introduction

Drawing can be considered as the "logical instrument" that humans have always used for trying to understand and envision their surrounding reality (de Rubertis 1994). Another "logical instrument"—geometry—articulates precisely the rules of drawing, acting as a fundamental support of scientific representation (Migliari 2000). In this field the digital revolution has fostered the development of rigorous representation methods. The syntactic and purely mathematical alphabet of the computer is now able to create synthetic elements and morphological patterns, eventually providing models of an either existing or envisioned physical environment (Fig. 1).

Computational design indeed has a tremendous intrinsic power of formal modeling, with potentially infinite spatial possibilities and configurations. For quite some time this ability was in the hands of skillful programmers who were

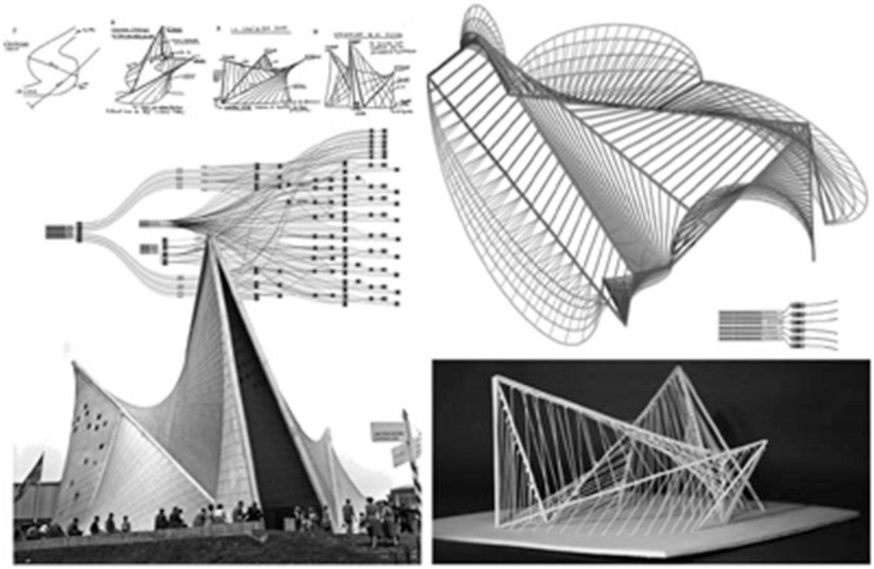

Fig. 1 Models of Le Corbusier's Philips Pavilion (students work, University of Perugia)

able to manipulate scripts and algorithms for 3D modeling. Over the last few years though, parametric software have evolved in such a way that mastering coding is not a necessary prerequisite anymore.

Starting from this theory and a applied research, it is developed a didactic of generative model. student's applications, it is interesting analyzing as generative tools change the way to design architecture as skyscrapers, bridges, stadiums, but also everyday objects as flowers, toys, the perfect diamond, cheese, pasta … Procedural logic and parametric modeling ensure a renewed control of shapes, products of an explicit path, and underwrite a renewed idea of model, really dynamic, in etymological sense.

A series of examples witnessed as generative model could be useful to generate new form for project aim, to understand morphogenesis in design field, to know form in architectural space, to think structure with an engineering approx. In fact, through generative model it is possible find the interpretations of form, the variation in a theme, the optimisation in solution.

2 Didactic of Generative Modeling

The digital language of parametric modeling can be thus expressed by a visual interface translating software procedural logic that would otherwise be formulated through strings of codes that are usually hard to understand by the average designer. In the modeling process then the attention focuses on the represented form, and the interface allows to understand its morphogenesis and the geometric rules that structure its digital development. In this merging between formal representation and geometric rules, digital modeling becomes more than ever a *generative* process that shifts the focus from shapes themselves to operations. In fact, several parametric software today embed visual algorithm editors that allow to easily manipulate intrinsic geometric parameters of the model that is being designed, as a sort of 'representation of representation' (Filippucci 2010). Such a parametric process thus empowers the designer with an ability to clearly build relationships between the different components of a model, and modify every single geometric parameter at any given moment of the whole modeling chain. If this modeling chain is well designed, then the new configurations of the model will be dynamically and seamlessly updated (Fig. 2).

Over time the relationship between designers, representation and the built environment has deeply evolved, and the recent digital revolution has dramatically changed the way in which we study and employ geometry in architecture: new software, media and interaction technologies allow the user to dynamically shape the 'model'—center of the design language since Galileo's scientific method. The combination of digital representation and mathematical techniques sparks a profound renewal of descriptive geometry research, too often reduced in between the two extremes of an anachronistic classicism and an innovative computerization without historical background (Fig. 3).

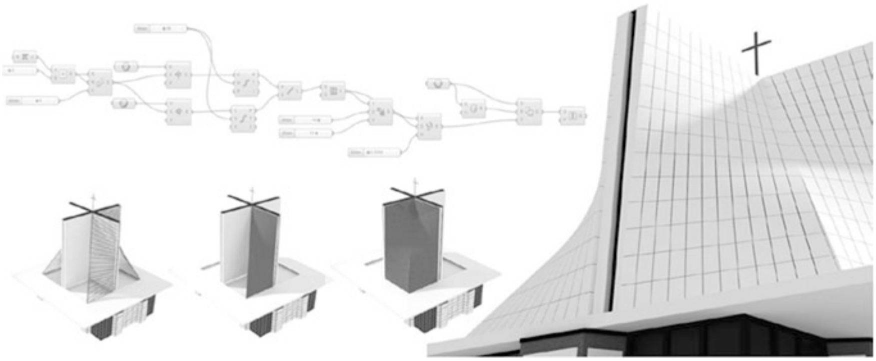

Fig. 2 Modeling of Nervi's St. Mary Cathedral: on composition and heuristic process

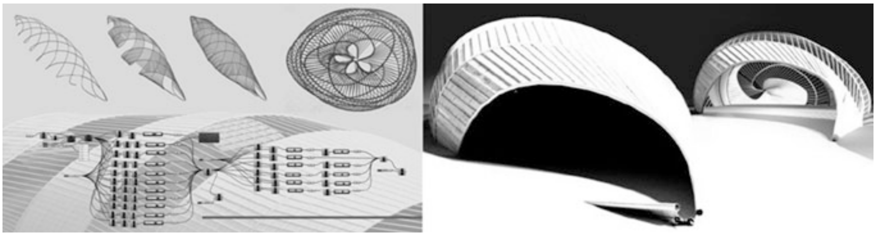

Fig. 3 Modeling of Toyo Ito's La Concha Negra Pavilion: on growth and form

Computational design then becomes an instrument able to reinvigorate the union of graphical representation and digital space (Migliari 2009). This process highlights what a form is made of, rather than what kind of form it is. If the digital revolution shifted the attention from the model to the visualization, then parametric design allows to regain possession of the infinite potential and dynamic heuristic of the model, making explicit its generative path and understanding the singular elements of the digital syntax. As a result, we are then able to assess a "critical analysis of the digital representation's performance," as the Italian school of descriptive geometry claimed in its Manifesto (Monge 1798).

Back in time, Monge wrote about a descriptive geometry that enabled a shift from "the known to the unknown." In parametric design the modeling process is useful to understand forms and their morphogenesis, highlighting the logic of the model for a better interaction, validation and iteration. The representation's action in parametric modeling is fundamentally defined by geometrical and mathematical parameters and algorithms. Values are required as input and the output information can be used as yet other input data for further operations, so forming a network of nodes and connections perhaps an ideogrammatic morpheme of contemporary hypertext communication. Therefore the parametric model changes the way shapes

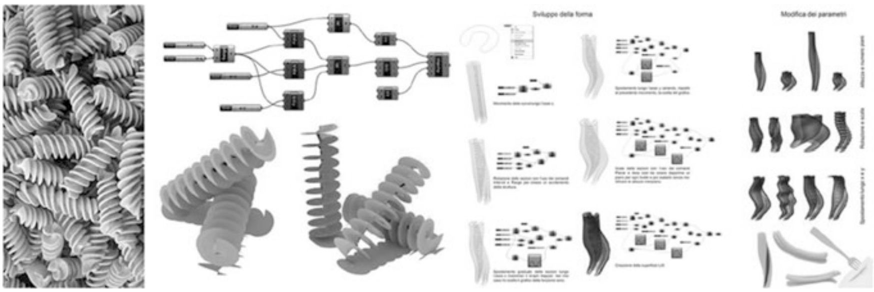

Fig. 4 Generating … pasta

and objects can be studied and developed, combining complex drawing and spatial understanding and questioning “the medium is the message” assumption (McLuhan 1964) (Fig. 4).

Through parametric modeling, employed as an analytical tool, geometry is described in a unexplored dynamicity that fosters experimental processes of formal generation. With an analogy with some studies about shapes of the natural world, models arise and are structured around a morphogenetic analysis of growth. The representation of relationships between elements highlight their structure and provide opportunities to maximize the generative procedure. Making this process explicit then becomes very useful at different levels: “To disclose mathematics means to disclose a tremendous source of knowledge, a wonderful source of inspiration and a powerful tool of creativity” (Maertterer 2007). The data structure then represents a sort of DNA of the model, which can be dynamically altered to create an almost infinite number of design solutions. By understanding this ‘analogical’ representation of ‘logical space,’ we can then reveal the *geometry of geometry*. As Leon Battista Alberti once wrote, “potrai tusenza pena, liberamente aggiungere, diminuire, tramutare, rinnovare, e rivoltare finalmente ogni cosa sotto sopra, insino a tanto che ogni e qualunque cosa stia come tu vuoi e sia da lodare” (Alberti 1450)[1] (Fig. 5).

3 Didactic of Complex Surface

Thanks to computational geometry and the digital revolution, the description and generation of forms is finally amplified. After more than 100 years from the theorization of curved spaces, the hybrid geometry, the definition of advanced

[1]The quote can be translated as: “*May you easily and freely add, reduce, transform, renew, and finally turn upside down everything, until each end every single thing becomes as you want and should be praised for*.” Alberti (1450). *De re ædificatoria.* Florence (Italy): II, capo primo, 34 (author translations).

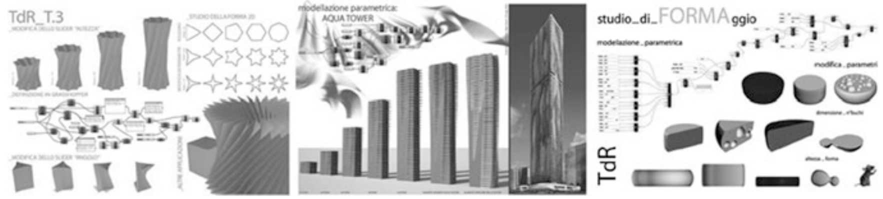

Fig. 5 Parametric variation on shapes, skyscreapers and … cheese

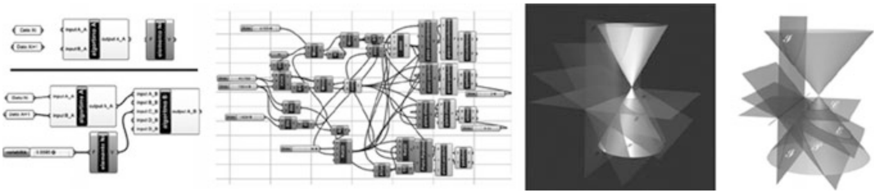

Fig. 6 Generation of parametric conic sections

algorithms for modeling, the parametric surfaces in triangular lattices and the definition of procedures for manipulating complex surfaces, allow for an architecture that replaces Vitruvius's static (static equilibrium) with dynamic equilibrium. Equilhybrids, hybrid equilibrium, kinetic equilibrium that abandon the concept of eternity in favor of immediate fixity, as if they were generated out of a photograph. The movement captured by a photo is fixed on an image and, at the same time, the form of movement is revealed in its representation. The shape emerges from its representation (Fig. 6).

In the contemporary research of new forms in an increasingly more complex and unconventional architectures, in the pursuit of their interpretative model, it becomes necessary to break the form into simpler, known and easily recognizable parts. Therefore in the revelation of the shape itself, it is our senses, our culture and our intuition that will interpret and thus reveal the unknown. *Knowing what can be recognizable* is a simple yet useful tool of meta-design.

The presented research is a path that, through the analysis of complex surfaces, recognizes the architectural forms, studies and interprets them, and ultimately gives materiality to them. The morphogenesis process, starting from the object decomposition into simpler pieces and combining unknown morphemes with hybrid shapes or defined patterns, then reveals apparently unknown and yet easy to create geometries. This is a process that unveils forms through a deductive path that is full of representative potential. An almost didactic journey that marks the shift from the Euclidean geometry to the NURBS geometry (Fig. 7).

The focus is the concept of interpretation, as a sort of morphogenesis place. Taking the reconstruction of a simple shape like a rugby ball as an example, it is clear that by starting from different shape interpretations different modeling

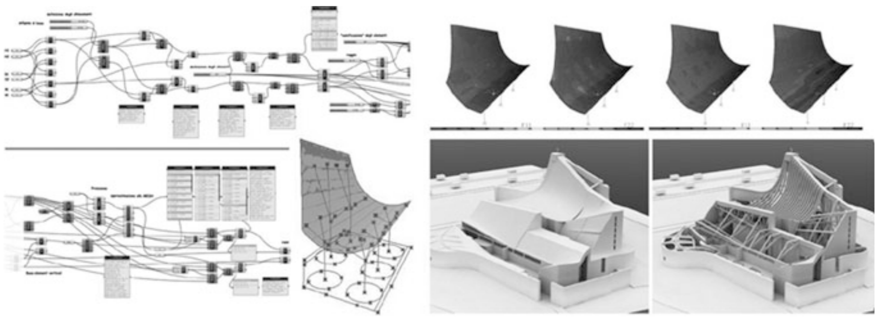

Fig. 7 Engineering process, simulations and parametric design

solutions can be achieved. Two emblematic ones can be compared: the first geometric interpretation takes the axis and a longitudinal section and defines a surface of rotation; the second one instead identifies a series of cross-sections and generates an interpolation surface. Perhaps amongst those two what changes is the accuracy level or the complexity of their construction process, what is certain though is that the two shapes are different because their genesis is different.

4 Didactic of Descriptive Geometry

In order to understand real potential of generative modeling in the field of descriptive geometry, a paradigmatic didactic path analysis has been proposed: it seeks to address major issues related to this method. Few modeling experiments here described are grown as a useful analysis to show the use of graphics algorithms in matters of descriptive geometry, as well as to highlight prerogatives of that representation. The logic of the process is realized through using generative algorithm Grasshopper, Rhinoceros plugin, but is extensible to other instruments showing same logic, not bringing specific commands, but their logic. The route description is finalized then to support its experimenting logic from those who approach for the first time with this instrument.

– Elliptic Hyperboloid

Modeling of elliptic hyperboloid allows instead of unveiling the great capacity of generative modeling solution. The base of the hyperboloid, a generic parameterized ellipse according to its two main beams, was split into n parts. The same figure has been translated along the vertical as a copy, defining thus interactively the height of hyperboloid.

The Division points of the ellipse are connected between them with lines connecting the corresponding ones, but to the list of points of the superior ellipse a translation through the Shift has been imposed that determines the inclination of the axes as well as configures the hyperboloid shape, which is alterable between the two degenerated extremes of Cone and cylinder. Once selected the lines through a loft the surface that can be verified as the ruled one can be generated. The simplicity of the method, ensured by iteration procedures, has to be underlined as one of the main prerogatives of generative modeling.

– Hyperbolic Paraboloid

Similar is the logic of hyperbolic paraboloid parameterization: starting from two non-coplanar lines, the same subdivision has to be applied on both in order to then connect the points obtained after having make a similar shift to the previous case shown. With a loft surface the shape—parameterized according to the positions of the two initial lines—has to be built.

By simulating its application it's possible to show a simple building application: construction and generation of the figure can be extruded as Tubulars assigning to each class an algorythm pipe, to configure the structure of the paraboloid.

If an equilateral paraboloid has to be built, it is possible to start from a parametric rectangle to get its vertices. Two of them have been moved on the vertical evenly and always parametrically, the translated points can be then connected with the contiguous ones in a segment, in order to then split the line and again, similarly to the previous case, to create the paraboloid. The parametric model allows you to view the properties of the geometric figure: revealing the duality of contiguous selectable vertexes then the two different equilateral parabolids obtained from the same points clearly appear (Fig. 8).

– Helicoids

The helicoids construction is based on different cases onto a common helix configurations. A ellipse has to be drawn and have to be divided into n points, then moved in series in order to get the rototranslation leading to the helix Director.

Different geometric figures can be obtained:

- by assigning with a pipe a thickness to the curve and getting la vite di Saint-Gilles;
- by placing a line at the base, still parametric, and getting with a sweep a generic oblique helicoid;
- by drawing a circle on the base and obtaining, in the case of circular section and using again a sweep, a torsa column;
- by scaling the same helix along X and Y and by connecting it to the originating in the control points with lines, to achieve a ruled surface or through a loft or through a swept on a track;
- the Theorem of Ruled Surface.

Focusing on the application of graphics algorithms to model surfaces, a first case study is that of the Theorem of Ruled Surface, demonstration presented by Monge in his early lessons of descriptive geometry (Monge 1798): given three generic skew lines, oblique only one striped line does exist, generated by them (Fig. 9).

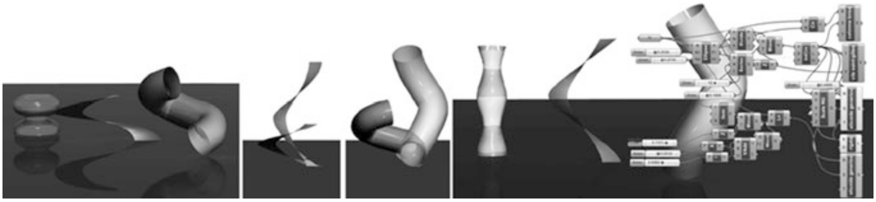

Fig. 8 Helicoids

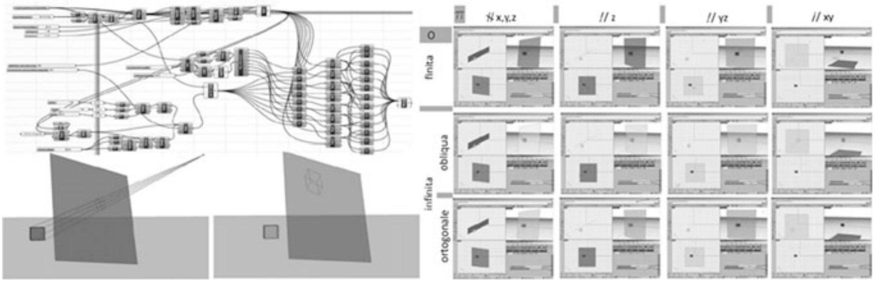

Fig. 9 Common genesis of representation methods

In the model three generic curves are taken as variables with the foresight to keep a spatial linearity in the selection order. After having divided the first curve in n variable number of parts, and after having taken a generic point “A” out of these, an extrusion is made out of this point until the third curve: the result is a cone. This surface will intersect the second straight line in a generic point “B” which produces with the first point A a generatrix of the searched striped plan. By iterating operations for the other n-1 points of subdivision of the first curve, the generating of the striped line it is obtainable which can be interpolated with a loft, with the serialism of the procedure becoming the strength of generative modeling.

– Unity of methods of representation

Redesigning in terms of generative modeling teaching observations conducted by de Rubertis (1993), it can be seen how parameterization could encourage on understanding how representation methods were born.

Being easily adaptable depends on the fact that once placed a generic object, i.e. a parametric parallelepiped, is easy to draw and to vary the other two fundamental bodies of representation. In a first model that dynamic representation can be obtained using interactivity of its instruments in favour of an increased usability of the model. The picture may be subject to rotations along the three axes and parallel the view can move up to a position so far that representation can be assimilated as an isometric projection. From projection and the point in which rays intersect each other connecting the edges of the object to the point of view it’s possible to get the sought representation.

The developed model is optimized in order to get a more special schematic representations already used in drawing practice, according to the proposal form of twelve methods. The goal is guaranteed by imposing to the two parameters increasingly stringent conditions: the generic framework variation is limited at first along the z-axis and then forcing the parallelism regards to XY as well as XZ (or any YZ), four conditions selected through an item algorithm off the list. Similarly to the viewpoint movement is allowed along three axes coordinated to parametrically define its position over, then is moved to infinity to get the oblique axonometric projections and once the orthogonality has been set to the square for the last class screenings projection.

By variation of selections on the two lists you will get twelve methods of representation. Even with educational purposes, the user or the teacher in order to show the common origin, starting from a generic condition, can freely rotate the square, moving location of the viewpoint and then imposing further conditions binding the square as well as the position of the viewer, moving from one example to another with great usability.

5 Conclusion

The eighteenth-century image of the "Manus oculata" (hand-with-eye) can be taken as a hybrid paradigm that perfectly embodies our interpretation of reality. It would be difficult to represent the shape of a three-dimensional object on a two-dimensional surface if it was not possible to see it, to understand the sensory aspect, to read it through touch. If this translation to the two dimensions results in a loss of plastic and volumetric information that can be perceived by only moving around the real object, then it is only by blending in a unitary image the different views that we are able to understand forms and spaces (Bianconi 2009). Also, our visual memory allows us to see much more that a single point of view would show. Without the contribution of stored data, our eye would have a reduced cognitive function (Fig. 10).

The hand-with-eye makes explicit the continuous relationship between the eye and the hand itself, and by extension what the relationship between the visual perception and the tactile perception defining the very design and representation act. The 'digital,' from *digitus*, finger, makes those relationships virtual. This paradigm makes it clear the link between the theoretical science based on speculative observation—represented by the eye—and the techniques of material production—represented by the hand. The human being knows what he is knowledgeable of, according to the operationalism. The hand then reminds to Galileo's *sense experiences*, whereas the eye refers to the ability of evaluation and of rational discrimination of phenomena, therefore to the *necessary demonstrations*.

Digital design and parametric modeling are new medium the open up new visions. The hand allows to understand new shapes. The tool has changed, the message has changed. However, the images in our mind always refer to our

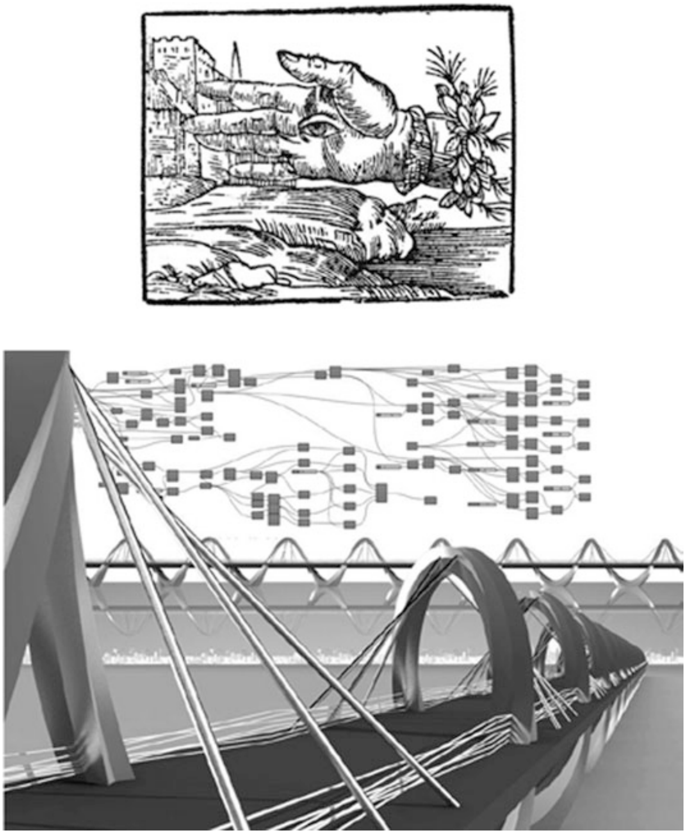

Fig. 10 "Hand with eye", speculative approach and operationism in design process and generative model

Euclidean understanding. It is not possible to think of curved spaces without referencing them to a triad. The rules of our mind can not be changed. It is instead possible to see with the hand, with the medium. New shapes can thus be found. And digital design is yet one more step towards the unveil of new horizons.

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Interactive Experience in Virtual Environments as a Project Tool

Mónica Val Fiel and José Luis Higón Calvet

Abstract Virtual environments allow producing forms of the experience and make possible, within the development of the project, the exploration of processes not available with other tools. The multisensory experience in the development of the project contributes to both, its spatiality and the temporality of its experience, and thereby evidences a series of relations that appear with the interaction of the projected ideas, through overlapping, immediacy, relation, etc. The interactive experience in virtual environments as a cognitive process for the development of the project allows its existential integration, the direct interpretation through the whole of the senses, and the experimentation on its potentials.

Keywords Virtual reality · Interactive environment · Immersive experience

1 Introduction

The evolution of digital technologies in the field of representation has called into question processes in which tools are regarded as purely instrumental.

Interactive experience is presented as a potential project tool because of its inherent qualities. The user becomes an active subject and movement, together with the spatial and visual limits, becomes a relevant part of the representation, challenging the exclusive domain of the visual. With the temporality of perception, the process-based nature of the project begins, driving the relationship between the work and the spectator and between the work and the surrounding environment.

Virtual Reality (VR) incorporates this experiential experimentation into project development and in this context, the tool transcends the attraction of its technology

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and becomes both an innovative medium and a potential tool for communication. So-called immersive environments enable, through the devices of location and positioning, real time visualisation of the project together with the field of action in relation to the movements of the user who moves around a scene which he or she perceives as built. In this way, these environments promote experience of a project as a physical and spatial yet intangible reality, providing a new phase of interaction with the ideas proposed by the student/user and with the form in which they are arranged in the proposed space.

The department of Architectural Graphic Expression at the *Universitat Politècnica de València* has offered a Master's degree course in Design Engineering since 2008, exploring the possibilities of virtual representations in various directions. Graphic expression, in its multiple functions, is conceived of as an analytical tool, an instrument for project development and a means of representation, among others. In the context of the master's course, the use of VR as a graphic expression and project development tool makes it possible to analyse and verify the ideas worked on in the project experientially. In addition, including the project in a virtual environment enables the communicative component of its representation to acquire an important role.

2 Context

Image technologies, in continuous evolution, constantly remake the ways in which we perceive the world and interact with it. This evolution has been driven by such diverse disciplines as medicine and art, where research is being conducted to find new tools and means of communication. The progress of technologies for graphic representation have transformed experimentation media and with that the interaction of users with tools (Human-Computer Interaction—HCI) and they are evolving towards immersive environments. The introduction of VR in the field of design and architecture has proliferated both in the field of research and teaching and in commercial application because of its potential as a communication tool (Fig. 1).

However, for several years now and in relation to architecture, the supremacy of vision above all the other senses has been called into question. Pallasmaa (2014, 7) states that the current serial production of images is even threatening our ability to imagine and, defending the role of the body as the locus of perception, he argues that architecture is multisensory, "the qualities of space, matter and scale are measured equally by the eye, ear, nose, skin, tongue, skeleton and muscle" (Pallasma 1996, 43). In justification, Pallasmaa refers to the processes of "temporalisation of space" and "spatialisation of time" in which the experiences of space and time have become fused into each other by speed. However, he argues that "the world of the eye is causing us to live increasingly in a perpetual present, flattened by speed and simultaneity" (Pallasmaa 2014, 138).

The organisation of time, the importance of the process, the task of giving physical shape to time, the duration in the change, among others, are ideas that

Fig. 1 Virtual reality (VR) incorporates experiential experimentation into project development. Immersive experience of students Paula Corredera Martínez and María Juan Gozálvez. Academic year 2014–2015

Solà-Morales compiles under the definition of 'Liquid Architecture': "A liquid architecture means, above all, a system of events in which space and time are present simultaneously as open categories, multiple and not redundant […]". Solà-Morales (2001, 33) has already proposed the challenge for architecture of representing this idea. "To give form to the synaesthetic experience of the flow in the movement of the metropolis, of the dérive that distances itself from the purely visual programmatic planning and the pre-established regulation in order to experience other events, other performances, is one of the basic challenges of an architecture that looks at the future".

Reinforcing this sensory and corporal condition, Montanter (2014, 3) argues that in architecture, experience is the key to including the subjective, perceptive, sensory and corporal condition, and thereby reinforces the phenomenon of architecture as a social construction. Montaner refers to experience in a threefold sense: Firstly, existential experience, in the sense of understanding reality, secondly, as a cognitive process through the perception of the senses and finally based on experimentation. “It is, however, reason and memory that permit the accumulation of knowledge based on a wise elaboration, interpretation and integration of experience” (Montaner 2014, 77).

The perception and experience of the user mark the difference in the theories of architecture between the ideal space and the *genius loci* concept of place, broadly developed by Norberg-Schulz. This concept, in his theories, places the ideal, theoretical, generic and abstract condition face to face with the specific, empirical, existential and organised nature of place. The geographer, Edward Relph studied *sense of place* from the same phenomenological perspective in the seventies for real environments and he has now transferred it to virtual environments (Relph 2007).

Although Relph accepts the connection between the two terms, he distinguishes between *genius loci* as the identity and spirit of the place and reserves the definition of *sense of place* for the distinguishing qualities of spaces, thus enabling him to organise his discourse for both real and virtual environments: “*Sense of place* is synaesthetic It combines sight, hearing, smell, movement, touch, memory, imagination and anticipation” Relph determines that “Short of some yet-to-be discovered process of social engineering, sense of place cannot be designed”. He concludes, however, in relation to shared use of space by different groups, that a virtual sense of place will develop through participation and commitment and is not necessarily different from a real sense of place.

3 Forms of Experience

Immersive VR applied to educational contexts makes it possible to learn concepts and resolve problems through active first-hand experience. Thus, a virtual world is generated which enables knowledge to be built based on direct experience and not on descriptions of the experience. Winn (1993) argues that “The psychological processes that become active in immersive VR are very similar to the psychological processes that operate when people construct knowledge through interaction with objects and events in the real world” (Fig. 2).

In *Cave* systems, where images are rear-projected onto screens, stereoscopic projection enhances the spatiality of the project. The user’s perception of the projected shape evolves as he or she moves around and the shape is perceived by the whole body. As well as the visual stimulus, hearing and stimuli captured by the kinaesthetic sense, which perceives position and movement, together with the vestibular sense responsible for balance, contribute to an understanding of the space (Hernández et al. 2011, 253). Interaction can be situated at a more advanced level if there are also haptic input devices like data gloves which can be used to select and manipulate the virtual environment, position, orientation, changes in scale, shape and colour, among other properties (Nan et al. 2014).

Fig. 2 CAVE *cave automatic virtual environment.* The Visionarium facilities at the Universitat Politècnica de València are attached to the information and communications systems office (Área de Sistemas de Información y Comunicaciones-ASIC)

In relation to the interactive process in immersive environments, three determinant aspects have been pointed to for appropriate user experience (McMahan et al. 2014, 285–311): Usability, task performance and naturalism. Usability refers to the quality of user experience during the interaction, including ease of use, ease of learning, convenience of use and its potential. Task performance in the system is linked to precision and speed to complete the task. Finally, naturalism of the interaction is linked to how intuitive that interaction is.

4 Interactive Experience

The subject "Design and Public Space" in the Master's degree course in Design Engineering proposes a project to design a small temporary architecture as a space to promote and support various activities at *Universitat Politècnica de València*. Although the location defined in the heading has always corresponded to public space sites at the university itself, it must be possible to insert the facilities in the urban public space. In this way, the formal and functional relationship of the planned installation with the immediate surrounding environment becomes a relevant variable in the development of the project.

The dimensions required for the installation in the project in successive editions of the course are characteristic of micro-architecture and so the planned spaces must be inhabitable and correctly dimensioned for the proposed functions. The small scale of the projects proposed in the subject enable the immersive experience of planned spaces in which the areas of interaction have been previously determined.

VR is a still expanding medium and so its definition is still in the process of change. Sherman and Craig (2003, 6) consider it to be a human communication medium and, simplifying their definition, they propose it as "a place that exists and that we can experience", and they emphasise that the key elements for experiencing VR are the *virtual world, immersion, sensory feedback and interactivity*.

The proposed virtual world is the project that each student builds and shares with the rest of the group.

Immersion is the mental and physical sensation of entering the designed environment. Sensory feedback enables the students to position their bodies in space and receive a response from the medium in relation to their movements. Interaction arises as the response students receive to their actions, which enables them as they walk around to integrate and recognise the project that each student proposes.

The interaction proposed on the course focuses exclusively on walking around and incorporates cognitive and motor components with control of movement from the point of view.

In an intermediate phase of project development the dimension of visualisation is transferred from paper or screen to a virtual space and a new simulated perception is obtained of it through an immersive experience. Within the iterative process in project development (elaboration of alternatives, selection, constant verification of ideas, etc.), VR is a tool for use at a certain stage of the project together with the other more consolidated computer-aided design tools. VR is part of project development, but the proposal is not to use it for the final visualisation of a finished process but rather as a tool in the process which permits a new level of interaction with project ideas (Figs. 3 and 4)

The student, in a preliminary phase uses *Cave preview* software to prepare the digital model of his or her project which will then be experienced immersively. The student selects the most representative points of view, decides which part of the installation to include in the *Cave* interaction area and prepares the exchange files for that purpose. These files contain the vector information that defines the geometry of the planned micro-architecture and data on the colour and texture of the surfaces. The spatial field of interest of the project is also defined in the exchange files by choosing the points of view to be shown and defining the volume that will configure the space subsequently represented in the *Cave* (Fig. 5).

In a second stage, the student interacts in the *Cave*, a $2.5 \times 2.5 \times 2.35$ m cube, defined spatially by three vertical screens and the horizontal support plane where the represented space is projected. The fourth side of the cubic space defined by *Cave* is left clear, to enable access to the inside space. The represented space is visualised by projecting it on the exterior side of the screen with video projectors so that the interior space of the *Cave* is diaphanous, and observers walking around inside it do not make shadows by interposition with the screens. The floor of the *Cave* also receives a zenith projection of the image of the represented space, in this case causing some obstruction which does not compromise the sensation of immersion in the represented three dimensional space.

When the exchange file representing the space to visualise has been loaded, the *Cave* user accesses it wearing goggles with sensors that define the position and

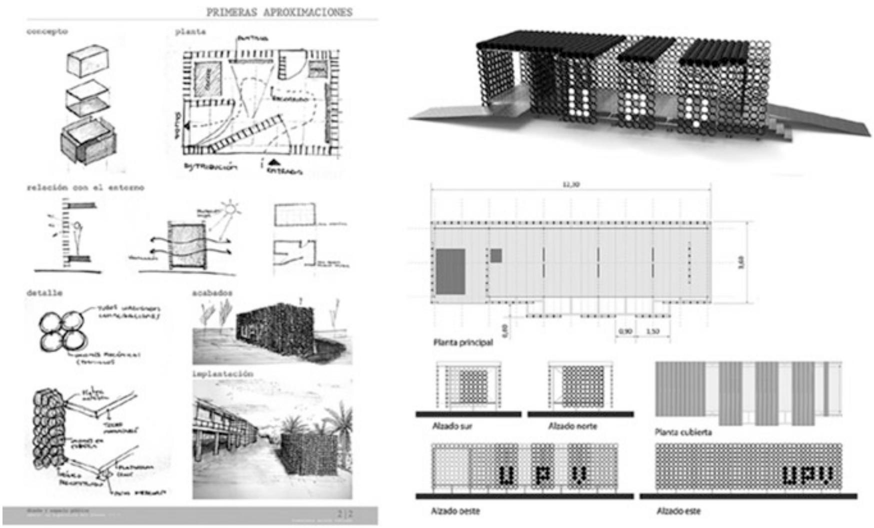

Fig. 3 *Left* First approximations to the project by Francisco Moreno Torrano. *Right* Development of the project by Francisco Moreno Torrano, Isabel Crespo Mengual, Tom Josset. Academic year 2013–2014. Virtual reality is integrated in the project development process as another tool in the process

orientation of the goggles inside the *Cave*. The goggles have polarizing filters to discriminate the image that each eye of the observer perceives, so the observer experiences stereoscopic vision to enable three-dimensional immersion in the project. The goggles have localisation and positioning devices that enable visualisation of the project to be updated in real time according to the student's movements as he or she moves about in a built scenario, and the student can perceive the visual sensation of inhabiting the space he or she has designed. The environment outside the dimensions of the cube is projected and integrated with the inside space, keeping the project linked to the area of action at all times (Figs. 6 and 7).

The level of feedback or information exchange between the user and the immersive environment depends on the formal determinants of the study project. Walking around the inside of the projected micro-architecture and visualisation of it while touring the inside enables the student to ratify his or her decisions on the project or decide on any changes to adapt it to the needs and requirements of the project outline. Although the rest of the project is part of the interaction area, in this case, in the interactive process, the user's walking around is limited by the dimensions of the *Cave* immersive environment (Fig. 8).

The immersive experience makes it possible to analyse and verify aspects like shape, dimension, sequence and rhythm, and also experiment with light, colour and materials. Although the response to the user's action inside the immersive environment is conditioned by the nature of the communication between the user and the system, in this direction and at a more advanced level, Sherman and Craig note

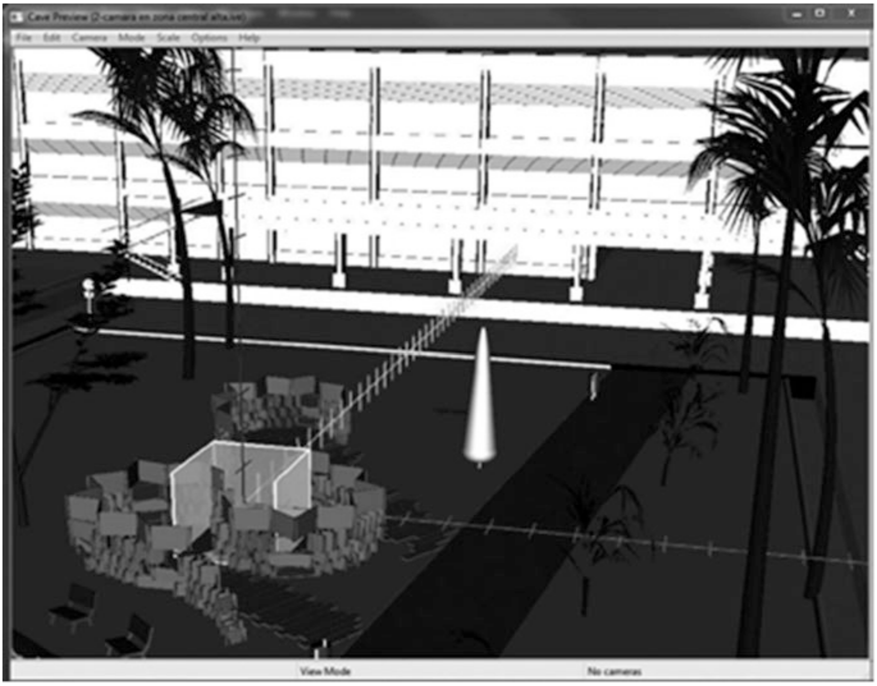

Fig. 4 *Cave preview*. In a pre-visualisation phase, the three-dimensional model which represents the microarchitecture is prepared for export to the *Cave*. Project by Mercedes Cepeda Zaragoza. Academic year 2010–2011

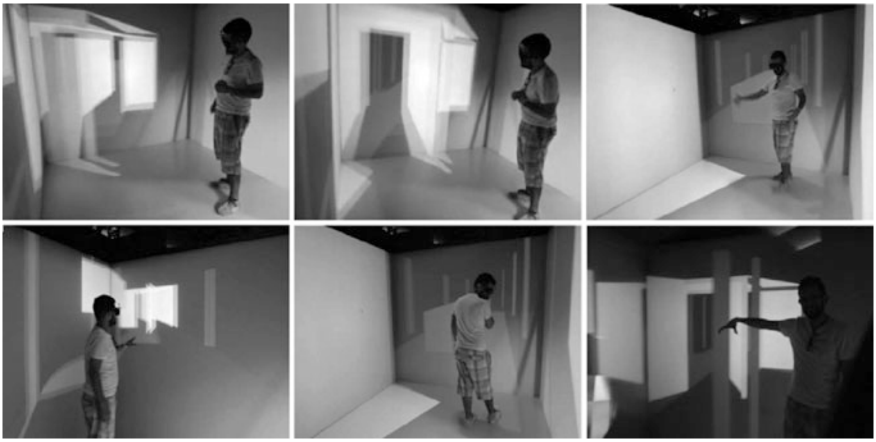

Fig. 5 Visualisation of the model *inside Cave* enables a walk around the planned space. Immersive experience of the student Antonio Cobaleda Cordero with his project. Academic year 2014–2015

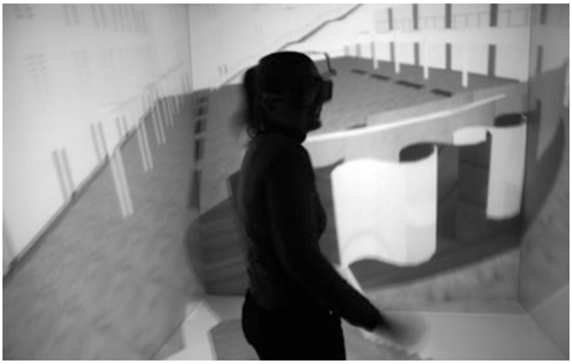

Fig. 6 The immersive experience enables students to verify the result of their decisions on the project. Eva M.[a.] Morcillo López. Academic year 2009–2010. The subject “design and public space” in the first editions “design of products for public spaces and collectives 1”

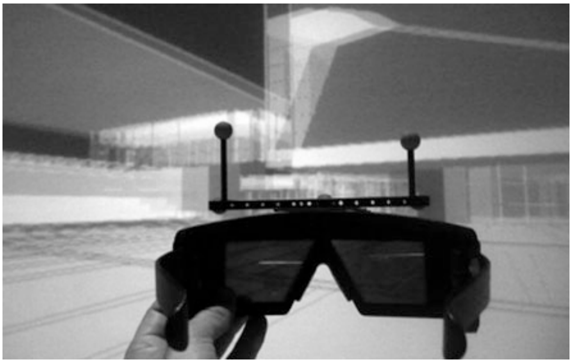

Fig. 7 The goggles have devices that can identify the observer’s position and orientation, updating the images projected on the screens in real time

Fig. 8 The degree of specification of the spaces represented in the *Cave* enable colours and textures to be added to the surfaces of the model. Víctor Manuel Bonilla Mengual. Academic year 2009–2010. The subject “design and public space” in the first editions “design of products for public spaces and collectives 1”

that as in the physical world, objects in the virtual world also have properties like shape, mass, colour, texture, density and temperature and even “Not all virtual objects have physical attributes, there could be something with no physical attributes, like a gust of wind or a spirit. You would know it was there by how it affected other things" (Sherman and Craig 2003, 406–408).

5 Conclusions

Virtual environments make it possible to produce forms of experience and enable, in project development, exploration of processes not available with other tools. Likewise, the multisensory experience similarly contributes to project development, both to its spatiality, and the temporality of the tour and evidences a series of relationships that appear through interaction with the projected ideas, by overlaying, immediacy, relation, appearance, among others, which become apparent from walking around and in which the sum of the parts is conceived as a unitary whole.

Interactive experience in virtual environments as a cognitive process for project development captures three core aspects: experiential integration, direct interpretation through all the senses and experimentation with the project's potential. Firstly, simulated reality anticipates experience of the project and approximates the project to a physical but intangible reality, recording multisensorial enjoyment immersively. Secondly, interactive experience in an immersive environment broadens interpretation of the project, including the subjective, perceptive, sensory and corporal condition. Finally, the simulated experience becomes an expansion of creative intentions and permits experimentation, analysis and validation of project ideas from a broader perspective. In project development it enables the exploration of concepts, objects and systems which cannot otherwise be experienced physically.

We are grateful for the collaboration throughout this long journey from the Information and Communication Systems Office (ASIC), and by extension the Vice-rectorate for ICT Technologies at *Universitat Politècnica de València*, who have made such quality services available to the entire university community.

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Graphic Thinking and Digital Processes: Three Built Case Studies of Digital Materiality (COCOON/Colombia, BANCAPAR/Chile, SSFS/Argentina)

Mauro Chiarella, Andrés Martín-Pastor and Nicolás Saez

Abstract Think strategic link between computer programming; digital modeling; the data; matter and CNC manufacturing in the various stages of the architectural project is key to update our discipline with new technologies. Our proposal to articulate and digital graphic thought processes; developable folded geometries and compositions is rooted in an expanded graphic thinking through multiple conceptual tools that are already part of the operational structure of our discipline.

Keywords Graphic thought · Digital materiality · Temporary architecture

1 Graphic Thinking and Digital Processes

The different systems of architectural representation generate, modify and/or confirm not only the ways of reading the architectural reality in relation to the mechanisms of perception but also the way of devising and conceiving architecture itself. By means of these systems of representation, graphic thinking—an evolving human construction—has allowed us to understand and explore the relationships between the design tools and the resulting architectural ideas, putting these into the context of the social-technical systems and the cultural paradigms out of which they unfold. It is hardly surprising that, throughout history, advances in the field of representation have had repercussions on the way that architectural space is conceived; the birth and codification of perspective drawing is one characteristic

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example of this. Similarly and more recently, other changes in the way of representing and conceiving objects brought about by digital processes are leading to significant modifications in our deepest structures of architectural creation.

In the context of these digital tools, the relationship between geometric knowledge and the exploration of architectural form broadens design resources through the rigorous geometric control associated with graphic thinking. Digital programmes have already resolved the problem of representation in instrumental terms, offering a wide range of automated graphic operations to control form, perpendiculars, tangents, angles, curve radii, etc. The architectural body is constructed in a three-dimensional space and moving two-dimensional projections appear on the screen automatically and effortlessly.

This subtle change of paradigm gets around the problem of representation ("building" a double projection was a real problem in the Monge system)—almost totally replacing it with the concept of the 3D object. The fundamental ideas, or geometric reasoning, take on, from the outset, greater importance than aspects of projection associated with representation. This by no means contradicts the objectives of the discipline of descriptive geometry, but rather takes it beyond the conceptual limits of the Monge system. In this way, graphic thinking (amplified by these new technologies) can be used to revise inherited geometric fundaments. Mathematical-geometric aspects can be understood, assimilated, resolved and strengthened through graphic thinking.

However, another instrument-related contribution must be added to this renaissance of descriptive geometry brought about by CAD, one arising from programming. We refer not only to mathematical programming but, fundamentally, to the programming of the geometric reasoning itself as a series of steps. The incorporation of parametric design adds a still deeper dimension to the problem of graphic thinking applied to the study of geometry. This new dimension concerns improving understanding of the graphic nature of a problem and also strengthening the creative processes since parametric programming offers not just one solution to the problem but a whole family of solutions. As we know, parametric design presents geometry from a mathematical-algorithmic viewpoint. Geometries are generated out of the definition of an initial family of parameters and the formal relationships between these. In these design processes, algorithms and advanced computing resources are not simply used to represent forms but also to create dynamic and variable design possibilities. Interest in the strategic incorporation of the concept of parametric design into the design process is rooted in the possibility of taking up new instrumental resources that broaden response capacities in design disciplines (Chiarella 2012).

In view of the above, we see that the fundaments of geometry are strategically interconnected with graphic thinking through the use of tools that serve to speed up visualisation (and hence the capacity for synthesis) together with the capacity to programme such thinking into more demanding chains of reasoning. These tools are able to seek complex solutions from within an enormous family of possibilities, leading us on towards new paradigms in the exploration of architectural space and form.

2 Digital Materiality

Digital materiality is an oxymoron. It is a conjunction of apparently opposing words, a supposedly contradictory conceptual construction and rhetorical figure that brings together both antimony and complementarity. At first glance, this impossibility comes across as a complete reversal of common sense with uncertain and provocative meaning, leading to questions that demand deeper reflection. Above and beyond the "representation systems" themselves, Gramazio and Kohler situate "digital materiality" in the existing and complex interweaving of computer programming, 3D construction (or digital modelling), data and physical materials at the different stages of the architectural project. Adhering to this concept, we understand this action, which begins as a digital process and incorporates materiality from the outset, as one aspect in a line of provocative thinking, both in terms of its expression and its production capacity; an action that establishes novel connections that broaden and enrich the relationships between conception, technology, manufacturing and the built environment.

The incorporation of graphic programming in the architectural project not only offers the potential to develop multiple design alternatives (by a logical formalisation of the process, its conditions and the geometric relationships). It also gives the possibility of strategic integration through multiple analysis variables, increasing the efficiency of the project from out of its own materiality. By presenting our built experiences in this field over the last few years we will analyse the different interactions between the digital model, relating databases, programming algorithms and design parameterisation for assembly manufacturing of non-serial components. These three experimental experiences have risen from a kind of thinking that, far from tending towards more complex levels of morphology, have tried to seek simplicity in the idea that generates the form. This approach is manifested in the developable geometries, appropriable sections and/or folded compositions, culminating in a numerical control manufacturing in coherence with the design systems used. The works presented here are examples of an operative and conceptual connection between graphic thinking, digital processes and digital materiality. They were realized through joint research projects involving the Universidad del Litoral in Argentina, the Universidad de Sevilla in Spain, the Universidad Nacional de Colombia and the Universidad del Bio-Bio in Chile.

3 Case Study

– The Cocoon (Medellín, Colombia)

The experience is a collaborative work between the Graphic Engineering Department of the Universidad de Sevilla and the Universidad Nacional de Colombia. It places developable geometries in a transversal and practical position, focusing on the architectural project and digital materiality and thus filling the void that exists between technical possibilities and practical knowledge of the new computer design methods. By obtaining complex parameters of a geometric nature to create building elements, basic geometric knowledge becomes the central concept of the project. Mastery of these geometric fundaments was essential for the digital design and fabrication of the Cocoon pavilion built by undergraduate students (Fig. 1).

This pavilion is of shared authorship and takes its conceptual inspiration from The Caterpillar Gallery, realized in the Universidad de Sevilla in 2014. The project's generating idea is to address the study of the "Theorem for the intersection of

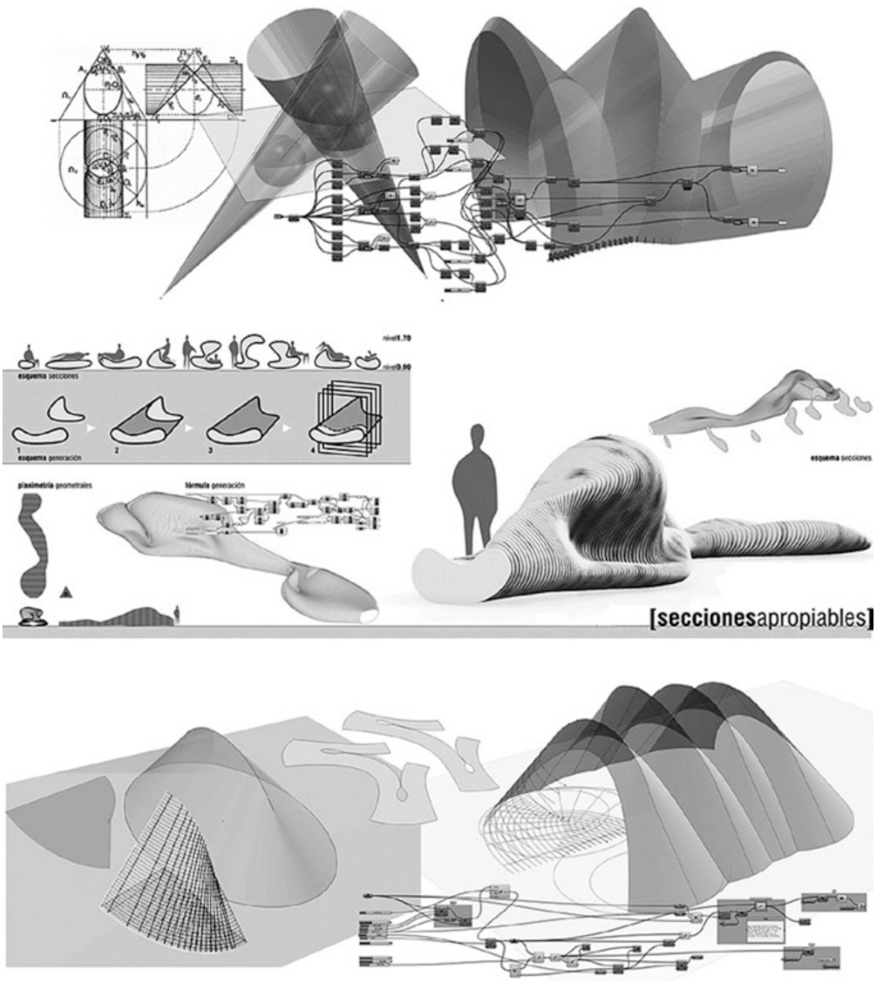

Fig. 1 Digital processes: The Cocoon (Medellín, Colombia); Bancapar (Concepción, Chile); SSFS (Santa Fe, Argentina)

quadric surfaces" attributed to Gaspard Monge, from the basis of the CAD-CAM instruments and the parametric algorithms. Concretely, the theorem states that: "Two second-order quadric surfaces circumscribed around a third second-order surface (a sphere, the simplest such form) or inscribed within it are intersected by two second-order (conical) curves." (Izquierdo Asensi 1985). In our case we conceive a sequence of cones that are always circumscribed, in pairs, to a common sphere. In this way we guarantee that all the intersections are curved planes and hence that the surfaces are developable.

This international workshop is offered to undergraduate students (with support from UNAL teaching staff) as a large-scale work for them to undertake together. The challenge is to design, digitally fabricate and assemble a pavilion articulated with the aforementioned geometric structure to give it a unified form.

The geometry provides a path that connects the more theoretical aspects with the more practical ones. It serves as an exploration of the architectural form (incorporating size variables, environmental suitability and economic variables in terms of the number of panels used) and as a resource to resolve each of the conical intersections of the corbel planes in an automated way.

The workshop begins with the development of each conical surface and a study of the corbels joining the surface with the anchor bracket. The required panels are also broken down into component pieces to be digitally manufactured. The manufacturing process was carried out and directed by the team from FabLab Unal Medellín of the Universidad Nacional de Colombia. Lastly, the pavilion was assembled with joint collaboration from the students and teaching staff from the Manizales and Medellín campuses of the Universidad Nacional de Colombia.

The teaching and research work developed demonstrates once again the key role that geometric knowledge plays in an architect's formation. It is equally clear that the use of CAD-CAM graphic media is absolutely necessary to integrate the fundaments of geometry with digital fabrication processes (Fig. 2).

– Bancapar (Concepción, Chile)

Bancapar ("*Fondart Regional 2013*" winning project) is a parametrically designed bench conceived as a public work of art. The project was self-managed with shared authorship and located at the entrance to the Faculty of Industrial

Fig. 2 The Cocoon (Medellín, Colombia)

Engineering of the Universidad del Bío-Bío in Concepción, Chile. The interdisciplinary work between university students and teaching staff and a group of researchers and teaching staff from the FADU-UNL in Santa Fe, Argentina transformed the proposal into a technological work of art without precedent in the region.

In the experience, parametric formulas were developed in a manner characterised by collaborative design between teams from two universities in two Latin American countries. We can observe how this process has dissolved the concept of the author (s) and his or her work through the use of a parametric system from the outset, thus achieving independence from the idea of any predefined form. The appearance of new fields of collective creativity induced the initial designers to use their own inventiveness to broaden and strengthen the imagination of the others involved in the process. The parametric formulas served as communication tools speaking a universal language that strengthened this creativity and enabled the original designer to lose control of the design process while still maintaining the same basic shared objectives and structure. The design is based on the parametric combination of nine guiding curves that act as silhouettes for the user to sit and rest upon. Each of these guiding curves is made up of steel gussets that provide a basic gesture of containment and ergonometric support for nine different body postures (different heights for sitting with or without back support, lying down or leaning in a standing position). This basic connecting geometric logic, the original objective of the project, provided sufficient flexibility to be adapted to the context of the site and to changes to the initial manufacturing proposal at the configurative stage.

At the configuration stage, the physical construction (initially planned to be CAD-CAM fabrication) was adapted to the technological resources available in the region. The initial possibility of CNC Wire-Bending fabrication (proposed in the FONDECYT Nº 3110025 project) was ruled out and the designers worked with printed graphic templates and manual-mechanical folding of each of the 106 pieces (5 cm wide 6 mm thick steel gussets). Three thousand kilos of steel was used, prepared for assembly, manually-mechanically folded, with each piece given a galvanised finish. The result is a unique object with variable dimensions along its approximately 10 m length and 2.5 m width. Folding the steel gussets confirmed how the properties of the building material and the manufacturing and assembly process chosen are decisive factors in defining the final form. The manual-mechanical folding process has a greater margin for error than the Wire-Bending systems, thus resulting in a certain distancing of the geometry from the parametric curve found in the initial abstract model. Since all the sides of the individual components of the composition are similar, they give homogeneity and identity to the whole. Once the margin of error has been accepted, a new geometric character appears that has the advantage of generating a less abstract, more organic language not foreseen in the initial parametric composition. In contrast to regular geometric compositions, a perceptual reading of the Bancapar does not easily reveal its overall form from any single viewpoint.

The creation of continuous three-dimensional surfaces through folding and the geometric extrusion of appropriable sections enable a mathematical and operative connection to be made between the desired technological, perceptual and utilitarian conditions (Fig. 3).

– SSFS (Santa Fe, Argentina) Same-Slope Folded Surfaces

In this postgraduate didactic experience carried out in the Universidad Nacional del Litoral (in collaboration with the Graphic Engineering Department of the Universidad de Sevilla), the folded composition is presented as a formal construction, an operative action and a sense perception. The experience has been a clear demonstration of the use of collaborative design. The initial graphic thinking (USevilla) was nourished by the strategic use of same-slope developable geometries to achieve manufacturing and assembly (UNL) of a temporary folded composition in a single working day.

The developable surfaces belong to a little-studied architecture typology that has proved very effective for manufacturing and assembling folded compositions. In this project we worked with same-slope surfaces. These are a subseries of developable surfaces engendered by the movement of a cone along the length of a directrix—in our case, elliptical arcs—with the surface determined as the final outer envelope of all the cones.

The form's generating idea consists in a same-slope surface support on an elliptical directrix (Gentil 1990; Izquierdo Asensi 1985). This initial module was taken from graphic thinking to parametric formulation, thus permitting an exploration of different formal combinations until our design objectives were reached. The geometric exploration itself led us to the knowledge of a series of totally unique points on the geometric surface that we present, as well as other special properties such as the natural progression from a continuous surface to a folded surface.

The design was created in the Graphic Engineering Department (USevilla) and the digital fabrication processes were simulated with a 1:8 scale model in FabLab Sevilla. Lastly, two modules of the full size pavilion were put to test by students from FADU-UNL (Masters in Architecture/Design and Digital Construction).

The result is a single, self-supporting, continuous envelope with high structural resistance. It covers a distance of about 8 m by means of a physical deformation applied by folding the material. Studies were made only from graphically parameterised variables with no rigorous technical information available on the material

Fig. 3 Bancapar (Concepción, Chile)

used (multi-laminate sheets of *guatambú* wood with three 6 mm thick layers), which has so far resisted gusts of wind of over 50 km/h (the *pampero* winds in the Litoral-Centro region of Argentina).

The necessary interactions between the digital model, the programming algorithms, the design parameterisation and the conditions of numerical control manufacturing have led to the need for maximum simplicity in terms of the idea generating the form, in order to ensure that any complexity is limited to the resulting form itself and not the production and assembly process.

In SSFS-Santa Fe, the various groups of FADU-UNL students have faced problematic situations arising from the experience of assembling external designs. These have arisen due to the interaction generated by the collaboration processes in the workplace itself and following the critical analysis of the first USevilla proposal. Thus, once the assembly work was finished, each group was requested to draw up a possible solution for, improvement to or assessment of the original proposal for the SSFS Pavilion. In this way, they acquired a commitment to go beyond a mere construction contribution to find their own critical viewpoint to solutions to any problems they observed. The experience of the collaborative workshop was carried out in a theoretical-practical way, alternating video conferences and in-person activities to provide a good level of exchange between teaching staff.

The whole pavilion was built on the researchers' European Night (Seville, 25th September, 2015) and named the SSFS Pavilion FabLabsevilla, part of an activity titled: "Developable geometries for building temporary pavilions".

In this experience, several determinants lent the project further complexity. The first was the limited budget available to realize the four modules in a larger structure and the second the impossibility of perforating the pavement of the chosen location, the Plaza Nueva in Seville.

The first determinant meant choosing the lowest cost material on the local market (with all its limitations): a 5 mm thick 2440 × 1220 mm MDF panel. The second obstacle, the impossibility of anchoring the pavilion to the pavement of a public square, opened the debate on how to counterbalance the structure's horizontal forces where it met the hard surface of the pavement. As a solution, transition gussets were placed on the surface along the length of two tied horizontal metal strips.

It was possible to prove empirically that, thanks to the geometric form and the morphology of the fold, the structure was completely self-supporting and undeformable in its final state, despite not being anchored to the pavement surface.

Lastly, the various experiences shared have been translated into an open, non-lineal procedure model to generate temporary pavilions with different solutions adapted to each specific context. This model receives constant feedback from the reflections, analyses and production experiences of each stage in the process (Fig. 4).

Fig. 4 SSFS Pavilion (Santa Fe, Argentina)

4 Conclusions

Graphic thinking with digital processes broadens available resources, incorporating the notion of digital materiality into the fundaments of geometry. Our recent experiences test ways of thinking and procedures that are not habitual in traditional architecture teaching and that derive from the strategic use of digital materiality in the creative processes. The ancestral inertia of architectural subjects together with the inability of traditional building materials to take on the demands of current spatial and conceptual quests are challenges to be faced if these post-industrial design and simulation technologies are to exist alongside industrial and pre-industrial building technologies.

In this way, numerical control machines, widely used in industrial design, are slowly being incorporated into the field of architecture with the promise of fabrication without intermediaries. These new architectural production techniques face the challenge of accompanying the complex projects generated by informatics tools, ensuring the complexity lies only in the geometries themselves and not in the production process. Digital materiality arises out of graphic thinking with digital processes, proposing new relations between the architectural object and its representation.

The slow implementation of the numerical control manufacturing systems attempts to redefine the instances of prefiguration and representation by rethinking the possibilities of a progressive transformation of some of the fabrication and construction processes in architecture. Rethinking and modifying the operational methodologies with digital fabrication in architecture forces us to abandon autonomy and a certain determinism in graphic thinking, which has for years been subject to an obsessive almost stylistic control of the designed object and a spatial structuring inspired by Cartesian logic.

The success of a creative process should not only be reflected in the ability to understand the complexity of every dimension of the architectural phenomenon in order to offer a suitable and flexible response to concrete situations. It should also contemplate the discovery of new conceptual and operational tools that broaden the very possibilities of design thinking.

Our proposal to articulate graphic thinking and digital processes, developable geometries and folded compositions, has its roots in a broader kind of graphic thinking and uses multiple conceptual instruments that already integrate the operational framework of our discipline. Strategic articulation between computer programming, digital modelling, data, materials and numerical control manufacturing at the various stages of the architectural project is key to achieving this end.

5 Credits and Acknowledgments

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BANCAPAR: Project design: Nicolas Saez (UBB), Mauro Chiarella (CONICET-UNL); Matías Dalla Costa; Martín Veizaga; Luciana Gronda (UrdirLab. FADU-UNL). Production: Luis García Lara (FabLab Concepción).

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SSFS PAVILION. SANTA FE: Project design: Andrés MartínPastor, Roberto Narváez-Rodríguez. Parametric co-design: Juan Expósito Bejarano. Academic coordination: Masters degree in Architecture, FADU, Universidad Nacional del Litoral (Professors: Rodrigo García Alvarado, Mauro Chiarella). Production and assembly: students and teaching staff from the Masters degree in Architecture. Consultation: Paulo Chiarella. Collaboration: Graphic Engineering Dept., Universidad de Sevilla, ETSIE, Fablab Sevilla. Records and editing: Federico Cairoli. Performance action: Ariana Beilis; Felicita Cersofio; Carla Tortul https://vimeo.com/135685179.

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Author Biographies

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Andrés Martin-Pastor He is an architect and PhD from Universidad de Sevilla since 2009. He is currently 'Profesor Contratado Doctor' in the Department of Graphic Engineering. His research career focuses on the study of geometry from the graphical tools, making a thorough review from the tradition inherited to new digital tools. In the context of the studies of systems of representation, we highlight the facsimile reproduction of the unpublished treatise "Artes Exçelençias della Perspectiba, 1688". And articles like "Contribution to the study of instruction in Geometry", in Nexus Network Journal, 17; "Poliedra as form of geometric knowledge" in EGA, 25; "The 1779 Relief Map of Cádiz: A unique project of military architecture in modern Spain" in The Cartographic Journal, 53; "The great unsuccessful cartographical Spanish project Century" in Imago Mundi, 68. About digital tools on geometry, highlight "The Caterpillar Gallery, Quadric Surface Theorems" in AAG y the works The Caterpillar Gallery; The Cocoon; SSFS Pavilion-Santa Fe; The Butterfl Gallery; SSFS Pavilion-Fablab Sevilla. The latter, recently awarded with the second National Prize (2015 Emporia) in Ephemeral Architecture.

Nicolás Saez (1973). Architect and academic staff at Bio-Bio. Magazine art director at FACD-UBB. His work and research concentrates on the visual arts, both within contemporary photography as well as within public art. He has exhibited his photographic work in Chile and abroad and has built three public art works in his hometown. Co-author and director of BANCAPAR project which received the CLAP Platinum 2014–2015 international prize to the best urban infrastructure. Currently, he prepares two camera obscura projects, one designed and built in mud with vernacular technology and the other designed with parametric design and digital fabrication.

Review Graph Tech Support from EGA Magazines

Elsa M. Gutiérrez Labory and Enrique Solana Suárez

Abstract Has been to identify two distinct types of papers. The first type contains research that is focused on the incidence of new technologies as a graphic form not only in the way drawing is now done but also the manner in which architectural projects are presented. The second type of publication includes articles and papers which explain procedures or the starting up of specific programs such as the use of CAD as an instrument. It is this two-sided vision of new technology that will permit us to establish the limits of our research.

Keywords Drawing · Digital representation · New technologies

This communication is the result of a first approximation in the research we are doing on the review of technical graphics support EGA from journals and conferences. So far, we have focused the study published by scientific journals architectural graphic expression EGA, published in the XXI century. We have identified those related to new digital technologies for the representation, in their own way to draw and build the project, from the genesis of the idea to its formal representation items. The first journal of this century is the no 6, published in 2001 and the last is the number 22 which was published in 2014. This makes a total of nineteen journals. The papers found are classified into two categories, those who have called "applications" which are those that have more to do with managing a program, ranging from as lifting surfaces warped 3D to technical rising heritage. And we have called "reflections on the digital representation of the project", that deal on how to operate in different phases. It is this second group of items where we focused our interest because they allow us to establish the current landscape of new

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digital technologies in the representation and in the actual operation of the architectural project.

In the nineteen journals published so far this century, we have found a total of 21 papers we attach to the first block and 17 papers we frame in the second block,[1] although some of them touch on a tangential way, they have been included in the list because they always brings something to the study. If we find that throughout these nineteen journals have posted a total of 347 articles[2], we can see that the delivery rate to either block is very low (6% in the first block and 4.9% in the second) for what is a subject that is embedded in the way we work and in our schools. The first papers of the XXI century related to what we call reflection on the digital representation, appears in 2006 in the journal no 11, five papers that had already appeared on computer applications. 2007 will be a year of turning, as three papers published digital representation. Otxotorena (2007), one of those who writes these three papers, points us in the same as in the eleventh EGA Congress in Sevilla in 2006 was latent concern that new media and the new representation, and it appears that as a result, appear in journal no12 EGA 2007, three papers that reflect on the subject. The same rise was once again given in 2011 where the numbers 17 and 18 with three papers each were published. And again an paper by Professor Otxotorena (2011) which establishes the connection to the previous EGA XIII Congress, in this case held in Valencia in 2010.

It should be noted publications that have made revisions to the papers of the scientific journal EGA. A corresponds to Professor Eduardo Carazo, in his paper "Model or digital model. The survival of a system", published in issue 17 of EGA (2011) provides a survey of the number of papers that talk about the digital model, since the beginning of the journal EGA in 1993. In his final footnote 5 tells us: "the question began to be discussed in the context of the EGA Conference in 1998 at the Second Congress held in El Escorial, with presentations like Canivel, or in the journal EGA in 1993 at no 1 Almagro although the photogrammetric application, and there is retreated to no 4, by Amado and Franco Monedero and Pozo, with a ratio of three twenty-five papers in this number. This proportion has not changed significantly over the past fourteen years, we should at least give pause, especially considering that the digital medium completely dominates the architectural drawing in the production centers of the same".

The other publication to take into account, up to the Professor Fernando Linares, in his paper "Journal EGA: 17 years, 14 issues, 266 papers" contained in the

[1]Of the 17 items found, so far they have worked with 11 of them, which are listed in the bibliography.

[2]347 articles published in 19 magazines EGA published in the twenty-first century are broken down as follows: EGA6-2001 (10); EGA7-2002 (14); EGA8-2003 (15); EGA9-2004 (12); EGA10-2005 (12); EGA11-2006 (13); EGA12-2007 (16); EGA13-2008 (18); EGA14-2009 (26); EGA15-2010 (19); EGA16-2010 (16); EGA17-2011 (20); EGA18-2011 (24); EGA19-2012 (27); EGA20-2012 (22); EGA21-2013 (21); EGA22-2013 (21); EGA23-2014 (21); EGA24-2014 (20). The nomenclature used is: EGA-number magazine-year of publication (number of articles published in the magazine referenced).

minutes of the XIII Congress EGA (2010). It classifies the subject of papers published so far in six categories: (A) Teaching, (B) Architectural Drawing and Representation (C) Theory, History and Analysis of Architecture (D) Equity and graphic restitution, (E) Art and Aesthetics and the last to collect (F) is that of the "New technologies" where "the issues that refer to computer-aided drawing, to technical progress and evolution graphics, CAD systems are compiled, manipulation and digital image processing, 3D renderings (renders), photogrammetry and photographic restitution, and any other technique or procedure that involves technological development or benefit in architectural graphic representation" (2010, 250). In their study should be noted that the items that fall under this heading are 15 of the 14 journals analyzed, representing 5.8% of the total, occupying last place in the standings.

The two papers referring to the weak implementation the subject of new technologies has occurred. We agree with Professor Eduardo Carazo in its final statement, and although four years have passed since it was published, we note that the situation has not changed. The digital environment continues to dominate, and often to the detriment of freehand drawing, and appears to be more pronounced in the academic activity at work. And Otxotorena (2007) argues that the new situation with the technology produces the marginalization of the drawing. It argues that the pencil drawing is threatened for the first time. We have unfinished business, think about it. Especially as it relates to academic activities. So far, in what refers to journals EGA, only two authors write about new technologies and teaching in schools and they are Otxotorena (2007) and Carazo and Martínez (2013).

1 What Say Those Who Have Talked About It

After reading all the articles we have in a group reflection on the digital representation of the project, we can establish a set of job parameters own computer: a graphical unbridled production, introducing new variables in the project approach, the enhancement of the geometry in the project, the resurgence of perspective, greater emphasis on the issues of color and texture, and sometimes the thought process is reversed, starting from the particular to the general.

The digital representation takes its importance with the computer, in the words of Uría "drawing computer is more focused on graphic production in the analysis parameters" (2007, 50). The pencil drawing is slower than a computer drawing development, leading the latter at a certain time to a production unchecked. "An uninhibited and just thoughtful production, subject to the pressures of a wild maelstrom that images and results overlap and consumed at full speed, outrageous dunks in competition for stardom where survival Pure Visibility is assimilated" (Otxotorena 2007, 66). This breakneck pace in the production of images, which does not happen in drawing pencil, and where people work with immediate sensations, makes critical reflection on the project lost. This operational change in the words of

Uría represents "the biggest revolution in the field of representation from the Renaissance invention of perspective and from the encoding of s.XVIII" (2007, 50).

On the other hand, how to work computer, using parameters, it can be brought into the project many variables at once. New aspects are introduced in the operation of a project, innovative aspects that the traditional way of working does not allow operation with them. Montaner argues that breaks the figure of the diagram as a new system to try to bring some order in the creative process (Puebla and Martínez 2010, 101). Temporal and kinematic appears in the process of creation as Puebla and Martínez (2010) tells us, the chart acts as a mediator for inter-relate the most complex phenomena. New variables that were previously difficult to manage are introduced.

The computer in turn has allowed the geometry, in the development of projects, acquire greater importance. Tranchana (2012) tells us that the machines are presented as new avenues of human expression, the traditional aesthetic criteria for operability is abandoned. The computer or better, certain computer programs allow us a different way of working. They work with parametric functions, mathematical key (if, for example, fractals) so that the solution is "unforeseeable" and thus the process of ideation is reversed, going from the particular to the general (Otxotorena 2011).

The way of producing images favors the resurgence of perspective (Carazo and Martínez 2013) is the final image power project as possible to resemble reality. With recovers renders color and texture images. The new image of the object of the project is presented as a means of miniaturized modeling. It competes with the completion of physical models, both in qualifying and the final image of the project. Figurative seeks perfection and the models themselves the time variable is introduced, allowing watch different routes.

The computer can display more variables in the project and therefore thinking more about the project. As Carazo Lefort (2011) points mediates mental processes, he speaks of computer-assisted projects. To Tranchana (2013) the digital code allows infinite modifications, absolute freedom and tremendous difficulty in delimiting the figurative processes.

Few authors, such as the case of Otxotorena and Carazo, articles refer to the computer in academia. There is talk of CAD more as an instrument, which matters more the result than the process. Foul explore, academic teaching, in the part of ideation, project, communication and construction through digital tools, understanding them as an extension of the mind, like artificial intelligence that amplifies our brain activity, as we pointed Muntañola (Carazo and Martínez 2013).

2 What It Is Meant by the Interviews

We could also read interviews with architects, who began publishing in the journal EGA from 2005, entitled "Talking with". Read interviews so far, noting that most of the respondents talk about the use of new technologies in the architectural drawing process. This allows us to have a vision of how to work in the studios today. From the reading we can say that, in architectural studies using the pencil drawing and the use of computers in all of them, though not with equal weight is maintained. This will depend on how the project is undertaken, in its nature and the way of work of the architect himself. Some, like Ferrater (2005) and Souto de Moura (2007), point to the importance of the computer to geometrization and they use it as a tool in the most complex geometries. Alsop (2010) and Tagliabue (2011) emphasize the importance of drawing by hand, it by the way they work, through painting, and her for being passionate hand drawing, although both do not rule out the computer in its study, even Benedetta tells us "to do architecture with everything, even without drawing" (2011, 17) the MVRDV group (2011) says that in the early stages of the architectural process in regard to the idea, it is more traditional, reserving the computer images for the end of the process. But they recognize that the computer can study many more options in less time.

Given the above we can say that:

The seventeen papers presented over the past fifteen years in the cinetific journal EGA that deal with reflection on the digital display of the project, are aimed at removing the computer all the potential it represents. The computer as a tool, where all that matters is the end result, is not the only option for usage. We have seen the work through diagrams, where many variables are contemplated, opens up many options in the development of a project. With this way of working, unthinkable manually, the computer is involved in the approach taken by the architect. Likewise, the computer allows us to exploit the geometric resources in shaping how the project object, causing the creation processes are reversed, starting from the particular to reach the general.

We must draw attention, in the same period, only two items, those of Otxotorena and Carazo mentioned above, refer to the role of computers in the teaching of architecture. The computer has been implemented in schools as teachers were learning either program and often teaching a subject was, and remains, given the program that knows the teacher. On many occasions, the teacher becomes commercial brand offered in its class. Therefore, the computer is used as a tool, but not removed, in most cases, the potential they provide. As we have seen, depending on the way they work, the way a project is undertaken or the nature of it, the use of the computer may appear at different stages of development of a project, from conception to final representation. Gradually the freehand drawing in the process of creating a project for the computer is disappearing. The abandonment of the drawing, like pattern of expression of thought, causes a loss of critical expression, essential in the formation of new architects.

Upon arrival of computers to our schools, there were supporters and detractors, who were positioned on the side of freehand drawing. At present, it seems that there is so much conflict, but the computer has been gaining ground at the expense of the pencil, reaching it almost disappear in many of the subjects that have traditionally used it. We must face the issue, it is not to exclude but to include both tools. The two must coexist, because as we have seen, what a sometimes brings not bring the other and we must equip students of all possible tools to deal with a project graphically, so that at the end of their training is he himself who chooses to give more weight to one or the other.

These early findings make us focus our next steps in the investigation to establish the state of affairs in the curricula of schools of architecture in Spain. Analyzing the subjects course to course and establishing a list of subjects with three entries: where is used only hand drawing, which is used only computer drawing and in which coexist both. In subjects where the computer is present we should establish if used as a simple tool where what matters is the end result or part in the ideation phase of the project.

On the other hand, complete with interviews, the situation of what happens in studies of architecture. In this respect attention should be paid to classify interviews several aspects that condition the use of the computer sooner or later, when it refers to the process of creating a project. The classification would be undertaken: for generations of architects interviewed, by the way they undertake the projects and the nature thereof.

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The Columbia Drawing Graphic Paradigm in 21 Century

Enrique Solana Suárez and Elsa Gutiérrez Labory

Abstract Our machines support production of graphic documents for architecture and design processes it, they were what we would call rudimentary; at the time, they were incorporated into the theoretical discourse, at least on teaching methodologies and procedures, and extending to the results produced. We intend EGA compilation of issues most relevant from this perspective, as the zero point of the research delves more rigorously and that is currently in development by our working group, seeking to confirm the proposed hypothesis, there is a New Paradigm for the Century Graphic XXI in Architecture.

Keywords Sketches · Tablets · Diagrams

Some three decades ago, many of which today we have our teaching and research activities in the area of knowledge of Architectural Graphic Expression, witnessing the emergence of personal computers popularized in our university environment, with her multiple applications for drawing and design assisted. Undoubtedly, it meant a jump in normal working conditions, and consequently, a major transformation in the forms of production and processing graphical information for architecture and urbanism.

Our new machines to support the production of graphic papers for architecture, and support the design process of it, were what we would call rudimentary; while, were incorporated into the theoretical discourse, at least on teaching methodologies and procedures, extending to the results produced. Great discussions were initiated about the value of his hand raised against the computer graphics, discussions about optimal or objectionable applications to which access had, many of the arguments generated speeches that today seem almost ridiculous as unnecessary.

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And we spent a lot of minutes, hoping that regenerates slowly representation by Columbia lines browser, support incorporating such a familiar application, as if it were a magic act. We wondered how to give students access to these devices, and how to incorporate them in our everyday activity. The time would bring the answer today is unimaginable teaching or professional activity without such supports.

From looks across the scientific literature produced and stored in the repositories of journal and conference proceedings EGA the paradigmatic lines that are currently in EGA defined, what we call the Graphic Architecture Paradigm for the XXI Century. They are the distinguishing lines between graphic tradition for the architecture of the twentieth and the current situation, all within the different areas of this. In this paper we focus on graphic design process, from initial fuzzy scores, to the strict representation gives way to geometric graphics settings.

The intention is to have a current view of the discussion that takes place and facilitates hypothesis testing and verification of the positions. This does not mean that the different contexts under investigation, there may be jobs that result or add elements to the discussion, however, and as a way of dimensioning were not taken into account.

We intend EGA a compilation of issues most relevant from this perspective, as the zero point of the research delves more rigorously and which is currently being developed by our working group, seeking to confirm the proposed hypothesis. This communication aims to present the state of affairs in terms of topics that define the range of the reflection that occurs in about those documents, using a few who have considered significant by their definitions and synthesis of a common thinking.

1 Three Objectives and Three Topics

We pursue therefore generally three objectives that must be overcome at the end of the investigation, and that this communication presented as a transversal review excerpts; the first to determine the state of affairs regarding the matter set out in this case, we present those reflections further synthesize opposing views during the inquiry process.

Secondly, the aim is make a critical review of articles in the EGA scientific journal and Congress Biennial EGA papers, produced from 2000; so that we can present the theoretical corpus which supports and follows the graph reflection on the expert field of Architectural Graphic Expressio.

Finally, obtain and demonstrate assumptions, the central to assert that in the course still less than half of this century, there has been, and can be identified, a consolidated return for graphic paradigm for the architecture as it has been traditional, involved in the modification of architectural thought and therefore of the tangible results of architecture.

These would be the three main objectives of this research presented now focused on three topics we understand summarize the general positions we have found in the first bibliographic tonnages we are developing. For this communication biased toward trigger graphics processes results in generative design principles.

We highlight three issues that must be considered in the field as described; the first based on the reflection carried out with respect to freehand drawing at the present time; the second, to the digital action to be inserted into the design process freehand; and third, as this combination occurs in contemporary use position diagrams for architectural design that results in what has been called diagrammatic architecture.

This topics we are going to refer to some specific items as we are sufficiently representative clarifiers and a shared position in the current debate of architectural graphic expression, thus centering on the main axes of reflection that is done. In any case, it is an open discussion is not intended to remove reasons to hold different positions, but can not be ignored reality and imposes advancing beyond personal positioning.

2 Drawing in the New Paradigm

We find of great interest the interview with F.D.K. Ching, by Hugo Barrios and Francisco Hidalgo in EGA scientific journal as a synthesis of a shared thought. In it the first exhibition about architecture in the MOMA, thirty-second year of the last century is remembered through models and photographs. Not being up to the sixties (1962) in the same place where the first exclusive exhibition of drawings of architecture is made.

He meant that drawings by the architect F. Lloyd Wright, and in it a position change occurs in the drawings, are now presented as a work with intrinsic value, what so far was something technical, or part of the process conception (Barros et al. 2015) architects. Sometimes leading to destruction considering them of little value against the power of architecture.

Asked about this Ching, and the definition of differentiating point between an instrument and be the work confirms the practical value of drawing on the display of architectural thought and architecture process, allowing the performance on it for clarification and modification, being able to produce new concepts from this process is what we call in previous articles Graphics Operators (Solana 2007).

He reiterates its instigator value and communicator during the design phase, the design as we know, constitutes an operating trigger of this process as many times have insisted. However, once this process, it agrees that this eigenvalue is left. We affirm therefore that this is the time in which it objectifies, representing a still picture of the design process.

When this process is not distorted in the search for a simulation of procedural drawing, these documents provide data of great interest to the clarification and understanding, as far as possible, of the mechanisms and processes resulting from the action of conceiving and designing the architecture. Allowing deeper understanding of the authors and extracting general principles that affect learning and teaching methods in architecture.

Ching audience that finds it difficult to determine a finite life for architectural drawings in which we agree. Therefore, it seems that we take for assumed the dual role of cartoon called ideation process architecture; triggers a portion tools for visualization, understanding, manipulation and transformation of architectural thinking; and other items with intrinsic value, capable of producing aesthetic pleasure and valuable expression of thought of a designer and meaning.

In conclusion on this point about the value of the drawing, adding that in addition to its artistic value, gives us emotional impact that triggers memories suggestions; and incorporate that time provide clues to understanding the processes of design, above its aesthetic value. This flexible in recognizing the plurality of utilities and meanings of architectural freehand drawing position rises while alert on this issue who falsify their quality seeking other recognition.

The respondent believes that the increase in value and appreciation is occurring towards freehand drawings, phenomena which are also reflected in social networks, is derived from the easy access and management technologies, paraphrasing his reflection, we can through action draw, produce drawings in place, and it becomes a matter of great appeal for his contemplative, surround and authentic singularity , in the search for the connection between the look, thought and stroke.

Moreover, the emphasis on the idea that has always been latent, the significant character of simple drawing and strokes, which seeks to display figurative meaning through the interpretation of the viewer, literally defining that "the idea is not to reproduce a scene but make it visible. This magic hand drawing, his ability to suggest rather than describe.".

The importance and relevance of freehand drawing, is not incompatible with the technological application of all the graphic potential that is at our disposal. There is no dichotomy between technology and freehand graphics. Growing up in competition to draw necessarily requires continuous and regular practice of drawing, as a necessary tool to learn how to view and analyze reality.

In these terms referenced Ching as representative of a general reflection, he concludes the interview, and we the first topic of freehand drawing changing paradigm. Proposes teaching drawing as a form of visual thinking and communication where the whole being more as a technical matter involved.

3 Digital Field and Drawing in the New Paradigm

Linking with the previous interview that ends in a direct allusion to the processes derived graph application development technology that has made it appear that the drawing is a matter of skill acquired against consideration as integral of the individual who drives on your mark on the perception of things around him in general, and in particular architecture, both in its analytical aspect and purposeful.

Advanced on this issue, we turn our attention to an interesting article by Antonio Amado and Fernando Fraga on the freehand drawing on digital tablet that could sum up the state of affairs, and derive a dynamic forward positioning. It was published in EGA scientific journal, focusing on what has meant the emergence of digital tablets as an alternative to laptops.

At the same time, this has triggered the development of specific applications for work freehand on them. This article emphasizes that the development of software for architectural drawing was differentiated processes freehand, however, the appearance of graphics tablets and associated applications, from the year 2010 a significant leap occurs.

Obtaining more powerful graphics cards and processors, achieves better quality results and improved simulation of the manual line on the screen that is resulting in a greater use for this purpose of these devices, but the process has been slow and has not yet been completed.

Improved stylus, as well as a closer relationship between the simulation of computer graphics and the fact the draw with traditional instruments, has led to greater access to the means of the architects in the graphic ideation processes of architecture. However there is still some distance between the action plan drawing with a graphic instrumental support (manual plotters).

The tips of the digital pens ever emulate best but become visible requiring certain abstraction of the physical part in this process, but we are convinced of two things; one that the technology will gradually solving and refining the interference between result and interface (Amado and Fraga 2015); Moreover, as was the case with rendering to emulate the material architecture that brought new materials whose textures and colors emulate the infographic imitators of those visions.

Today this form of our visual culture, the machines have been removed from their role impersonator to become productive elements itself, establishing outside material Imitation proactive results. Similarly, graphics tablets, whose applications are born as imitators of graphic techniques, they gain self-worth, and what became the digital search for those, starting to put some distance between them and become a producer itself results graphics techniques founded earlier, they build new forms of expression.

And all these process are normalizing and ordering a new form of graphical construction freehand interposing tablets for their development. Therefore, it takes a differentiated way to approach the graphic, and both modes conception, although the theoretical basis of observation and stroke remain the same, processing capacities and reproduction becomes infinite.

This for some it means a loss of intrinsic value, yet we share the view (Amado and Fraga 2015) to consider the interest of a digital sketch is on the drawing itself, and its significance beyond its repeatability or handling, assuming that we have a new graphical tool that necessarily leads to a change in the paradigm.

And of course, it has an educational projection that has been slow to address, probably due to human limitations interest. The renewal of teaching methods is a central issue that once produced, will unleash more powerful and faster, a new graphical paradigm applied to the action of freehand design processes.

4 Diagrammatic Graphics Design of Architecture

Although the diagram as a seed in architectural design is sufficiently known, the truth is that it seems necessary to undertake reflection on its role in the field of architectural graphic expression to determine theoretical frameworks to understand more deeply, what are the origins, limits and differences in which we operate, particularly to establish the implications for the initial graphic processes of architectural ideation and the paradigm shift.

The formal definition of diagram at any terminological dictionary of authority, establishes that this object is a geometric drawing used to demonstrate propositions, solve problems, or plot the shaping law of a phenomenon; in another formulation: it is a drawing to show the relationships between the parts of assemblies or systems. These generic definitions, could also absorb without great difficulty, some formal characteristics of the initial sketch or sketches of architectural ideation in terms commonly defined.

We must recognize the high trigger ability of diagrams. The graphic interpretation of a highly complex reality requires decomposition into coherent systems to rationalization as tools for understanding of the whole, the sum of which we know will never be equal to all (Aristotle 335aC).

The complexity is not representable in its entirety, because it is elusive; they are fragments, yes, highly abstracted those who enjoy the special. At this point, it appears that the contribution of subjectivity in the choice of abstract systems that are considered most significant, will result in certain diagrams that result from the choice of author.

The diagram is constructed by analyzing the complex reality, trying to synthesize in significant geometric structures, but as open systems and transformable, and capable of further development, as if it were made germ. It is open work that integrates different variables that are continuously rectified (Montaner 2008).

In this extreme complexity, we are in the area of parametric design, where the confluence and modification of certain variables produce formal results are beginning to distance themselves from the architectural tradition from the outline, this from the initial moments in shaping the architectural project, so its influence in determining a new graphics paradigm becomes apparent.

New dynamic compression and decompression of information through diagrams, leads to new positions regarding processes for designing graphics. Polysemy and multiple drifts that enables this new situation, determine a modification of the parameters that is being acted. Loss coding and abstraction diagram variables are powerful enough to pose in depth the measures to be available, and to ensure continuous generative capacity diagrams (Figs. 1, 2, 3 and 4).

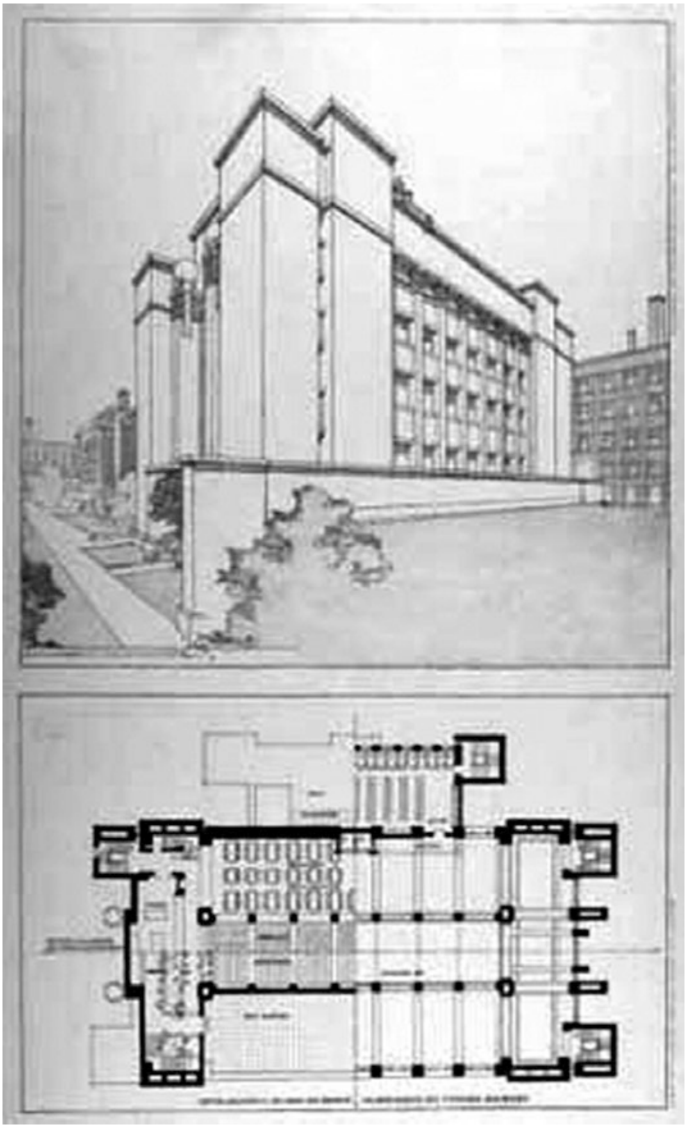

Fig. 1 Drawings exhibition Wrigt, MoMA 1962

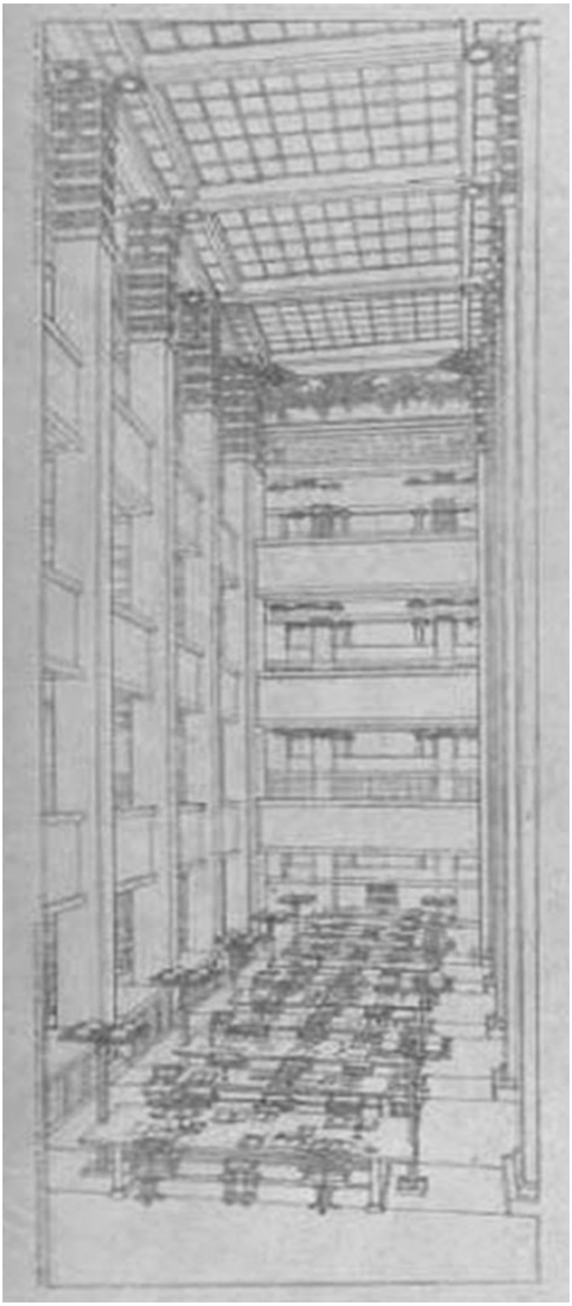

Fig. 2 Drawings exhibition Wrigt, MoMA 1962

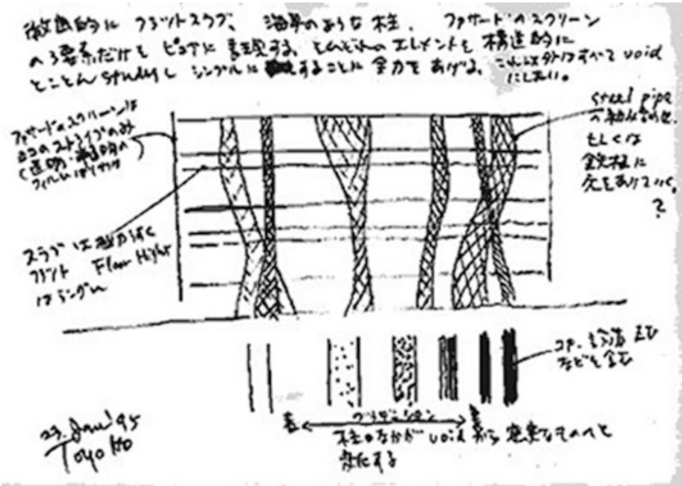

Fig. 3 Diagrams Toyo Ito 1995

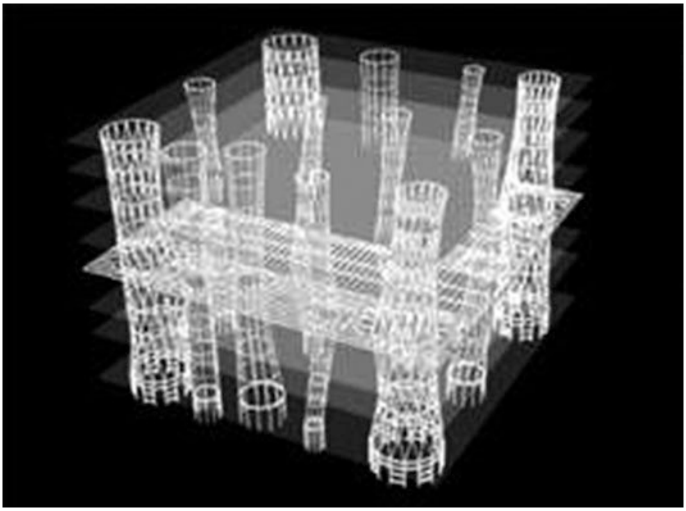

Fig. 4 Diagrams Toyo Ito 1995

5 Conclusions

Is evidence of a paradigm shift graphic in this century will bring consequences amendments in graphics design processes that have a material expression in the results as has been common in the history of drawing for architecture; and must necessarily trigger teaching methodologies that can assimilate, regulate and prioritize their implementation in low coding processes in the draw.

The drawings resulting from the action of architects to process their thoughts on finding satisfactory formal results, maintain intrinsic value regardless of the time of use, its value being part of the meaning in the process. This position is novel because this debate still exists in certain sectors.

Standardization of digital processes in graphs, are a fact at the user level, beyond the academic position that relies, for what current students in schools of architecture incorporating them into their personal routines in many cases above the programmatic requirements of the training lines.

The use of diagrams in the germinal design process, requires a graphical abstraction of high intensity, introducing profound changes in the forms of access that way to tackle the graphic support of architectural design, altering traditional mechanisms of action, with consequences also in training to be undertaken.

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3D *Printing* as a Technological Tool Geared Towards Architecture

Pedro Molina-Siles, Francisco Javier Cortina Maruenda, Hugo Barros Costa and Salvador Gilabert Sanz

Abstract 3D technology marks a major breakthrough in architecture; however, it requires a new approach. 3D printing, regardless of the field in which it is used, inevitably involves reinventing one or other process. For example, in the machining of industrial components, there are certain limitations whereby certain features of the design, such as inaccessible cavities, for example, are simply unable to be replicated. 3D printing does away with these limitations, opening up a new paradigm where most of these processes are now possible. This paper analyzes how 3D printing has the potential to become a new technological printing tool geared towards architecture.

Keywords 3D printing · Technological tool · Architecture

1 Introduction

The use of printers that are able to print in three dimensions is undergoing a huge growth at a dizzying pace. In the past two years, an increasing number of articles have appeared concerning the potential application of this new technology to a number of production sectors, and even on an individual level. With this in mind, the government of the United States has given its backing to a project that will see the introduction of a 3D printer in the classroom of each education centre in the country. For a leader such as Barack Obama and for a society that has become more

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and more aware, the future is in the promotion and the development of creativity. An educational, social and economic model that has a long road still ahead of it, but which must be stimulated because creativity, among other aspects, can not be left lagging behind.

2 Background and Applications of 3D Printing in Different Sectors

In 1983, the cofounder of *3D Systems*, Charles Hull, invented a printing process that used a solidified liquid photopolymer resin that was applied using an ultraviolet laser. The creation of an object using digital data: the very first method of 3D printing. It was given the name photo-solidification printing. Years later, *3D Systems* commercialised the first stereolithographic printers, geared towards the production of small, light, industrial parts for the aviation and automotive sectors. At the end of the same decade, new printing techniques began to be developed, such as selective laser sintering (SLS), whereby a laser selectively melts a powdered material organized in layers on a base, through the scanning of transversal sections.

The techniques continued to become more advanced until the advent of extrusion printing, which used fused deposition modelling technology (FDM) to print. This printing method used thermoplastics such as ABS and PLA, and even edible materials such as flour, among others. At the beginning of the 1990s, 3D injection printing was developed and later commercialised using cartridges containing different materials in a liquid format applied to a base using injection needles.

In 2005, at the University of Bath in England, Dr. Bowyer began working on a project that involved printing prototypes that self-replicated, the so-called *Replicating Rapid-prototyper (Rep-Rap)*, in other words, which were capable of replicating themselves by printing their different component parts. The *RepRaps* marked a major leap forward in access to and the normalization of this type of printer.

In 2016, the world of 3D printer design is already a reality in a number of fields, and is becoming more and more common, even in the non-specialized press, with news articles appearing about the different uses for these types of printers. We find ourselves at a pivotal moment in the use of this technology. According to journalists, entrepreneur and physicist, Chris Anderson, considered by many to be a visionary and idealist of the digital world, we find ourselves on the verge of a new industrial revolution; a change in the creation, production and product distribution model. His ideas are fully developed in his book entitled *Makers: The New Industrial Revolution*.

The fields of study that this technology can be applied to nowadays are many and varied. Not only are these printers being used to improve and develop tasks and their outputs, but the use of these machines appears to have given birth to a new breeding ground. The application of 3D printing in sectors such as medicine is increasing. All manner of implants and prosthetics are being printed. This results in a fall in production costs and the customisation and adjustments made to the parts in a much quicker and more functional manner. There is even research being carried out into the printing of human organs and living tissue from stem cells, which would imply a major change to the current transplant model.

Another field that is moving forward in great leaps and bounds involve the printing of food products. In the case of these particular printers, the traditional ink cartridges are replaced by the ingredients of a specific food, which are combined in the desired quantities using specific software to obtain the product to be consumed. NASA is very interested in this practice and intends to send a 3D printer to the International Space Station to allow astronauts to print their own food using food stuffs that are rich in proteins and vitamins.

If we now move our attention to the world of 3D printers for private individuals, thermoplastic printing using ABS and PLA of small day-to-day objects are now accessible to everyone. According to a study carried out by the Bauhaus Weimar University, individual households could save up to €1600 a year printing off everyday objects. It has been confirmed that the growth of these personal printers in the turnover for the manufacturers of 3D printers, reached $425 million in 2012, 43% more than in 2011. For 2016, Madson Inc. (a consulting firm specializing in information technology research) forecasts that the market will reach the $670 million mark, $135 million of which will come from the end user market. In other sectors such as engineering and architecture, this type of printer makes it possible for a prototype to become a reality in a very short period of time and at a much lower cost, without having to rely on external manufacturers.

In architecture, the advances made in 3D printing have not been limited to the printing of small scale models of constructions, buildings or even large urban areas, but there are already different construction projects underway, the ultimate aim is for them to be printed, and some have already been completed. Currently, a large number of companies are backing this technology, with many of them putting forward different printing solutions with the application of different materials. Let us quickly take a look at some of these projects.

3 Printing of Individual Parts for Later Assembly. Thermoplastic and Bio-ecological Materials

One of the groundbreaking projects that are exploring new frontiers in this field is *Project dome*, by Norwegian designer, Gerard Van Nen Marck. It is a collaboration project that anyone with a 3D printer can sign up to. Based on a three dimensional building design comprising 5332 individual parts, each interested party and participant in the project will print one of these parts. Assembly of the parts (printed numerically) is expected to take place during the latter months of 2016. The material to be used is thermoplastic ABS or PLA.

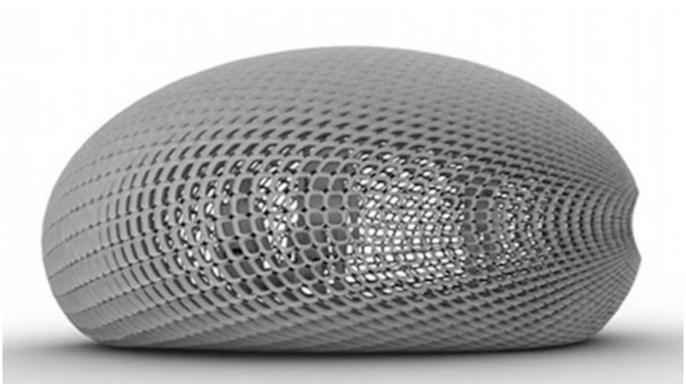

Fig. 1 The *dome project*

On other fronts, Dutch firm OFA Architects with its own *3d printed house* is printing the different elements of a traditional Dutch house in sections, and these will be assembled on one of the canals in the north of Amsterdam. The different pieces are subjected to testing where they are manufactured, and are then transported to the assembly point. The façade of the building will be printed as a single piece. The materials used are bio-ecological (using organic raw materials), although it is also possible to print them using different recycled plastics. The project is expected to take three years to complete. The company allows visits to the site where the home is to be built to see the printing of the different pieces, the progress being made, assembly, structural and material testing the pieces are subjected to,

Fig. 2 Close-up of a component part of the *dome project*

etc. The different rooms are being printed separately using a *Pruhakmaker*, 3D extrusion printer (Figs. 1 and 2).

4 Printing with Natural Materials: Wood and Rock Dust

Another Dutch project, *Landscape house*, in the shape of a loop and inspired by the Moebius strip, was designed by architect, Janjaap Ruijssenaars, founder of *Universe Architecture*. The development of the home has the collaboration of mathematician and artist, Rinus Roelofs, and Italian inventor, Enrico Dini, who developed the D-shape printer. This machine will be used to create hollow volumes using ground up rock or sand taken straight from the ground with which to build the home. These will then be filled using concrete reinforced with fibres to provide consistency. These will then be used to create the desired form, in other words, adding layer upon layer like any other 3D printer, making it possible to print and shape directly without needing to rely on formwork. The aim is to use this material is for the dwelling to blend, as far as possible, into its immediate surroundings. For its steel and glass façades, standard building techniques will be used (Figs. 3 and 4).

Danish architects Frederik Agdrup and Nicholas Bjørndal, part of *Eentileen Arkitektur* became associates of British firm *Facit Homes*, experimenting with *printed architecture,* to build a home, *Villa Asserbo*. With a surface area of 116 m^2 and just two bedrooms, it was built using 820 sheets of moulded plywood, using a 3D printer, with wood from a sustainable forest in Finland. Steel was used for the structure and assembly and glass for the windows. Nevertheless, the building has no

Fig. 3 The future *3D printed house* along one of the canals in Amsterdam

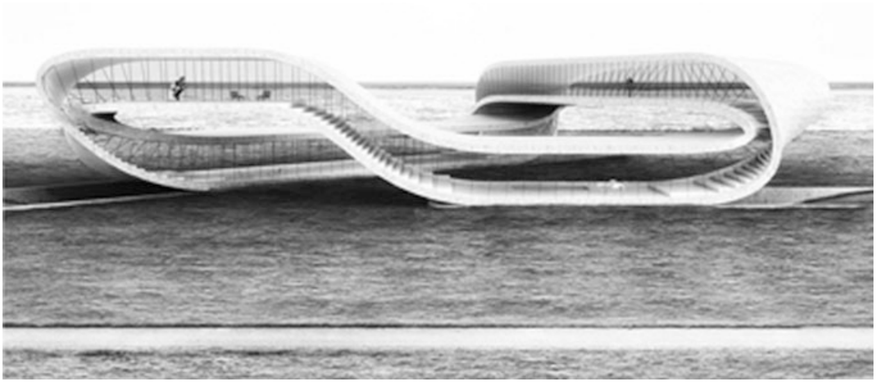

Fig. 4 The Moebius strip at *Landscape house*

Fig. 5 The two bedroom dwelling of *Villa Asserbo*

concrete and its supports comprise 28 small screwed in struts, which allows it to be transported should it be required (Fig. 5).

5 Printing Using Cement with Admixtures

In April 2014, Japanese firm Anwam Design Co., as part of its *ANWAM 3D Printed Building* project printed a group of 80 m^2 homes, and at a very affordable price. The partitions of the home were printed using the addition technique (and all were built using cement, but this time the printing was carried out with the house rotated, so that work on the partitions and the gable roof was carried out simultaneously.

Fig. 6 One of the homes from the *ANWAM 3D printed building* project

Once printing was completed, the home is rotated, and all that is left to do are the fittings and the exterior wall coverings. Following a number of projects working on the development of this system and the materials for printing, the company patented a large number of materials, such as plasters and cements that are reinforced with specially designed glass fibre. The material used for printing is recycled building waste products and industrial waste. The company aims to build 50 factories in Japan and this will enable them to recycle waste materials for 3D printing (Fig. 6).

Californian company *Printed Constructions* developed a project that began at the *University of Southern California* by Professor Matthew Davis, who back in 2011, could already foresee the future of this technology. The *Printed Constructions* project (the same name as the company), dealt with the complete printing of a home using a large-scale printer and for the material, an admixture cement, not requiring formwork, to achieve the desired shape.

Printing using this cement will be carried out like any printer, adding layer upon layer. Gaps will be left for the later fitting of doors and windows, and even for the installation of utilities. The partitions will be entirely carried out using cement, leaving an inner hollow, like an air chamber, used for corresponding insulation or additional concrete will be poured into them to join both sides of the partition. For the designers, this type of technology will enable the construction of a 150 m^2 (approx.) home in just over a day, the whole construction process will be fully automated (as is the case in other industries) and only a light finish will be required to create a cosier and more customised interior and exterior (Fig. 7).

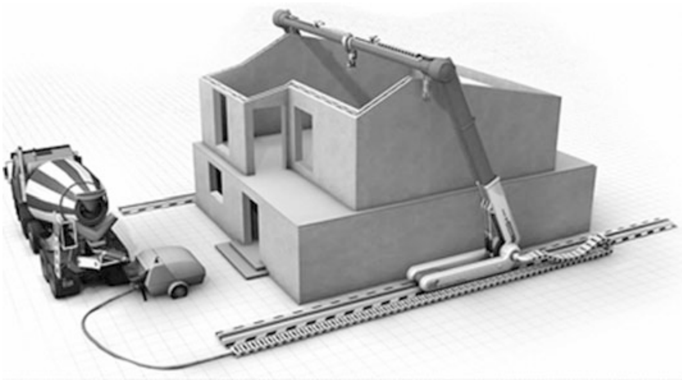

Fig. 7 The printer for the *printed constructions* project

6 Graphic Techniques to Generate Complex Shapes

As part of the *Graphic Techniques to Generate Complex Shapes* course taught at the Department of Graphic Expression in Architecture, part of the *Foundations of Architecture* degree course at the School of Architecture at the UPV, we are carrying out a study of projects that use this new architectural approach, namely that whatever can be conceived can then be printed using a 3D printer. Furthermore, we examine the limitations and uses that these printers, which are geared towards architecture, can have.

As part of the course, students are introduced to how one of the many printers that can be found today in the marketplace operate and are used. We start off by making a drawing, a two dimensional model and we firstly establish a set of directives with the basic commands of 3D design, always taking into consideration the ultimate aim: printing. Secondly, a simple printing rule is established and we then go on to print the 3D model that was designed, using different materials (thermoplastic ABS or PLA), analyzing the speed of the printing, the scales, etc., in order to examine and ascertain the potential that our printer offers.

Finally, with the model printed, we examine the possible advantages and disadvantage that might arise from working with this new tool in the classroom. This provides the student with a new perspective of a design that is specifically focused on being printed. Furthermore, we aim to analyze if this is compatible with our current architectural drawing and design teaching practices (Fig. 8).

Fig. 8 Printing in the classroom

7 Conclusions

3D printing might become a new technological tool geared towards education; for classes in design, experimenting and the creative impulse in the field of architecture. A field that encourages innovation and the use of this technology to improve learning, the dissemination of knowledge and the creation of projects at the University.

In architecture, the building of an architectural model is quite time consuming, sometimes taking weeks and even months to complete, and furthermore, the results depend on the skills of the person carrying out the work; a task which is undoubtedly handicraft focused. In 3D printing, this condition is removed, stemming from the fact that there is no need to leave it to the hands of an expert to get results. With this new form of printing, one can practically achieve any shape, however difficult it might be. We can create sets of simple architectural volumes that we can quickly print and that help us with the design process.

In architecture, adapting to this new type of printing will not be an easy task; it requires a fresh approach to thinking, to looking at things for example, during the design process. We no longer have to make designs that are geared towards software that enables us to obtain an architectural *render*, a visual representation of the model that greatly resembles its real appearance. Now, we must design taking into account that this object, building or any other model we design will be able to be printed. There is no doubt that we are witnessing a new era in architecture; this said, to be able to achieve this, we will obviously have to accommodate certain changes.

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From Integrated Design to BIM

Giovanna A. Massari

Abstract Nowadays the project disciplines have to deal with the procedures of Building Information Modeling and Management, i.e. with modeling and management of data concerning the work of architecture and engineering. However, this new way of working has the ancient purpose of real-integrated, interdisciplinary and transversal design, which now seems actually feasible for several reasons. Compared to this change the tradition of drawing and its own theoretical and scientific fundamentals can play an important role, because the tools of representation have always been the essential support to the implementation of the intersection between building disciplines and arts. In the last few years at the University of Trento a team of teachers has tried and tested the applicability of BIM to real cases of design, construction and maintenance with special regard to architectural themes, their structure and plant engineering.

Keywords Interoperability · Parametric design · Virtual building yard

1 History

Since technical and MEP matters became important for architecture, it has been to carry out a *good architectural design*, which should be able to solve rising problems on building processes with mutual adjustments of form, function and structure. This definition of the *good architectural design* remained unchanged until technical and MEP matters gained more and more importance and a complex role in architecture. The new idea of *integrated design* needed more refined tools and procedures, which are also more sophisticated, to manage the whole design. Even if integrated design seemed to be different from the simple design also in the method, it revealed to be completely comparable to a simple design.

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In the 50s a conceptual question arose in many countries. The term *integrated* began to focus on the need to examine all the phases of the building process at the same time and on the objectives of an harmonious development of each phase (from the concept to the execution). This term also implied the attention to every constituent element by considering each of them a part which define the same object. In the 60s and 70s the first attempts to regulate the design process took place. They tried to improve the methods used in architecture and civil engineering, known as *integrated and coordinated design* (Sacchi 2015). The purpose of these attempts was to use new criteria to establish clearly rules for the practice of architects and engineers at first. The Italian law n.143 which was passed the March 2nd, 1949 to regulate professional fees and its revisions clearly defined the steps, which had to be considered parts of an integrated procedure in the design phase.

At that time this regulation concerned structures and infrastructures, MEP, furniture and, in some cases, economic analysis. Moreover, forecasts of interferences in manufacturing during building construction, checks on energy consumption and economic sustainability, comparisons between different design solutions, the construction site efficiency, monitoring the works development, checks on the production of components together with warranties and certifications, the maintenance management and the evaluation of the obsolescence of the building were considered by the law. To the integrated design were often associated the first time optimization procedures in planning and building, such as PERT (Program Evaluation and Review Technique), with the purpose of monitoring dependent tasks which are functionally interconnected. At that time a management of all the procedures that a project team habitually use to know, predict and realize the whole construction process was supposed (Archibald 2012). This management of procedures needed to a good knowledge of the building, actually known as *BIM* (Building Information Modeling).

In the same breath the first CAD system was devised in the early 70s: it was thought as not a mere transposition of the manual drafting into a computer system, but as a tool which allowed the parametric modeling. This radically changed the way of developing design by creating and highlighting connections among the different component parts instead of focusing on single elements. As a consequence, a better management of the time dimension was possible (Woodbury 2010). At the beginning this innovation and CAD system were implemented by car and aviation industries, which benefitted from huge financial resources. Only when the hardware costs decreased same years later, CAD system entered the construction sector. However, it was used as a tool which could reproduce the manual drafting with the purpose of producing tables without taking advantage of the parametric modeling (Aish 2013).

In 2003 Autodesk introduced BIM and a new way of thinking as well as building design began to spread finally. In ten years this radical change has reported so a considerable success that in 2014 the European parliament passed the public procurement reform, known as EUPPD (European Union Public Procurement Directive), to recognize BIM design as a procedure to plan public works and to encourage Member State to adopt it. For instance, Finland and UK have already transposed this directive in law and starting from 2016 all the public procurements, which will be funded by the State, will have to be managed only through this new way of design. Other European States, such as France and Germany, are going to adopt this directive, while in Italy the transposition seems to be far away even if BIM design continues to boast of an increasing success.

2 Theory

Nowadays the integrated design target that was outlined a few decades ago, focused on a real fully-integrated and interdisciplinary management, seems actually possible due to a new way of conceiving the building process and working in architecture and engineering fields through BIM (*Building Information Modeling* or, better, *Building Information Management*). BIM is a dynamic and shared information platform aimed at data modeling or, more properly, at data management related to a built work (Sacchi 2015).

The reasons for the gap between the largely unrealized intentions of the past, and the revolutionary events we are witnessing are different. First of all, the new convergence of once separated software tools (spreadsheet programs, data bases, CAD-CAM, rendering programs, etc.) allows the development of a coordinated, graphic, parametric and multi-access digital model.[1] In other words, we have a real chance to incorporate and process in the model all data needed to design, to build, to certify, to maintain and to convert the buildings, according to hierarchical criteria and including their demolition. Architects, engineers, technicians, contracting and executive companies may represent, describe and design spaces, structures, systems, subsystems, components and finishing products using 3D objects that are associated with a range of key information; these are vital in the efficient and effective development of the building process (Eastman et al. 2012). Thus, by definition BIM is 4D because time is one of the parameters managed in the model; time is one of the most important vital keys in the planning and monitoring of the different stages of the buildings' life cycle.

In the building sectors, operators note the growing complexity and the resulting costs. They are more and more convinced that adopting BIM methodologies eases the deployment of best practices and the introduction of innovative processes, such as prefabrication with systems and components, automation and numerical control production, building process sustainability and its outcomes, quality certification of products and production phases, prevention and safety in construction works, Project Management procedures (Baker and Garret 2011). Architecture and engineering must be designed as a system of components; a set of values is related to all the variables of shape, quality and cost, and is associated with each of them. The various specialist skills should be able to interoperate and data flow should be available and

[1]An infographic model favors the look-visual expression of data neglecting the textual one; a parametric model contains numerical constants that can be changed depending on the objectives.

shared in real time by all stakeholders: designers, customers, administrators, managers, builders, providers, plants engineers and maintenance technicians. A coordinated digital model allows the efficient data storage and management, the preventive virtual simulation of each phase of the building process, not only of the design one, as well as the representation according to variable but previously defined levels of detail (LOD).

BIM offers real benefits that begin to be documented in literature: the interference checking and the reduction of non compliance between parts, therefore the reduction of design costs; the shortening of building times, therefore the reduction of building costs; the planning of the construction yard depending on the supplies of materials; the preservation of the existing real estate value by adapting to the functional and energy standards; the optimization of procedures and resources, thus increasing overall efficiency; the simplification in decision-making and generation of technical documents; the encouragement for prefabrication concerning not only the series production but also the custom made one; the availability of online libraries of virtual components and their performance characters (Miramonti 2014; Osello 2012).

More and more we hear about the fifth, sixth and even seventh BIM dimension. It is now known that 5D modeling refers to cost control, but few people have already experienced 6D procedures for the maintenance or have included sustainability aspects in an additional 7D level (Bimpanzee.com). The central issue relates to interoperability, one of the main factors of development of complex distributed systems. The interoperability culture can enhance the quality, the replication and standardization of heterogeneous informative models, but it requires a broader vision that includes both the technical aspects as well as the normative, economic and organizational ones.

3 Experience

Since a few years at the University of Trento a research group applies BIM methods to concrete experiences of architectural design, building and maintenance; the aim is to facilitate the approach to the latest procedures by small-medium professional and business realities also. In fact, BIM is very often regarded as a necessary climb, owing to the inclusion of new standards in the invitations to tender, but it appears too difficult to undertake. This feeling can be muffled just by knowing and sharing tried and tested working tools. Project Management, Construction Management, Facility Management and so on: these are recurring words that seem far removed from everyday practice, simply because we don't try to use them starting from delimited and more governable problems in our job, thus changing the ways of project and building management.

We are investing in the following directions: BIM and cost control (real-time computation); BIM and interoperability (integrated design); BIM and project management (fourth and fifth project dimensions); BIM and yard planning; BIM and maintenance management (sixth project dimension); BIM and prefabrication; BIM and building components inventory. The research objectives follow a dual track. The first one leads to the definition and sharing of a system of knowledge to be valid also in the professional and business, reflecting the contribution of innovation that the university may give to the territory where it works. The second one is directed towards the establishment and the strengthening of educational programs that cross many teachings and are joined in the common desire to give young graduates specific skills to address and direct the complexity of the architect's and engineer's job.

Three years ago the experimentation started applying BIM in the design process of a kindergarten in Manfredonia (Italy) designed by the architect Matteo Clemente (Rome).[2] It was immediately clarified the misunderstanding that BIM is a simple 3D modeling we can identify with the use of a software. Certainly 3D modeling is the backbone of this set of procedures but it isn't the only one. Probably it isn't the most important neither, because BIM creates innovation processes through the setting of workflows (Fig. 1). The coordinated model allowed to manage the output data to produce surface area and volumes assessments, charts, structural checks, executive and detail drawings; above all it allowed to perform predictive analysis on costs, metric and evaluative calculations, energy needs and anything else may affect the real building project. The research didn't process a single and comprehensive model, but it defined one procedure to which multiple complementary models from different application can be related (Fig. 2).

Almost at the same time an experience was carried out on the relationship between BIM tools, integrated design and building yard management of the new Istituto Agrario school complex in S. Michele all'Adige (Italy) designed by the architect Alberto Cristofolini (Trento).[3] Also in this case the workflow connects the architectural model, the structural one, the plant engineering project. Five BIM models are combined into a single master file in order to coordinate the different disciplines and check the interferences. The management of design errors (Clash Detection) identified the main causes of resources waste due to CAD: excess of information, problems in the interpretation of documents, presence of wrong information (Fig. 3). The planning of the construction yard progress with project management tools led to the study of an effective WBS (Work Breakdown Structure: project breakdown into defined working phases) to manage the metric calculation, the works planning (Gantt chart) and the

[2]Roberto Scalzotto, *Il futuro dell'architetto integrale. Il BIM come processo di progettazione*, master's degree thesis in Building Engineering-Architecture, University of Trento, a.a. 2012–2013. Software: *Graphisoft Archicad*, *StruSoft VIP-Energy*, *Microsoft Office Excel*, *OmniGraffle Pro*.

[3]Stefano Colombelli, *Progettazione integrata e organizzazione del cantiere con procedure BIM*, master's degree thesis in Building Engineering-Architecture, University of Trento, a.a. 2012–2013. Software: *Autodesk Revit*, *Autodesk Navisworks*, *Acca Primus*, *Microsoft Office Excel*, *Microsoft Project*.

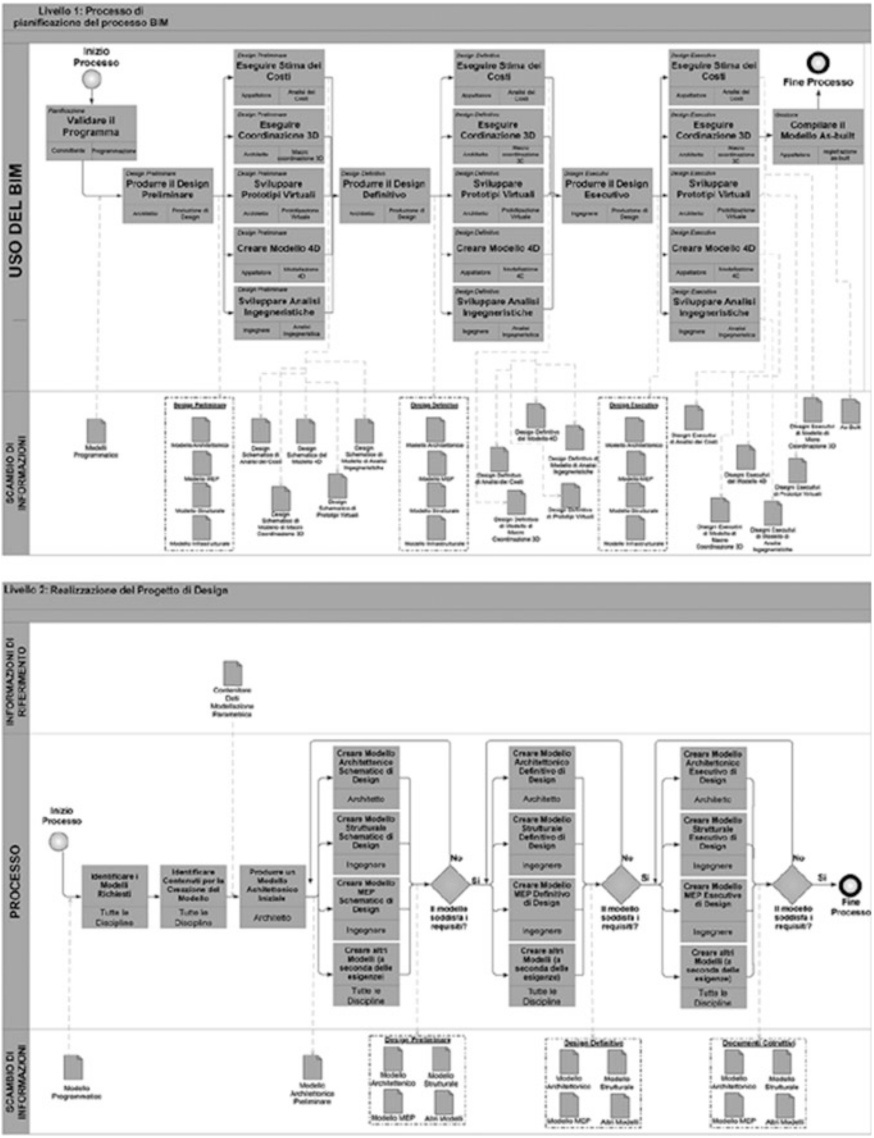

Fig. 1 The planning of BIM process (*above*) and the execution of the workflow (*down*). *Author* Roberto Scalzotto

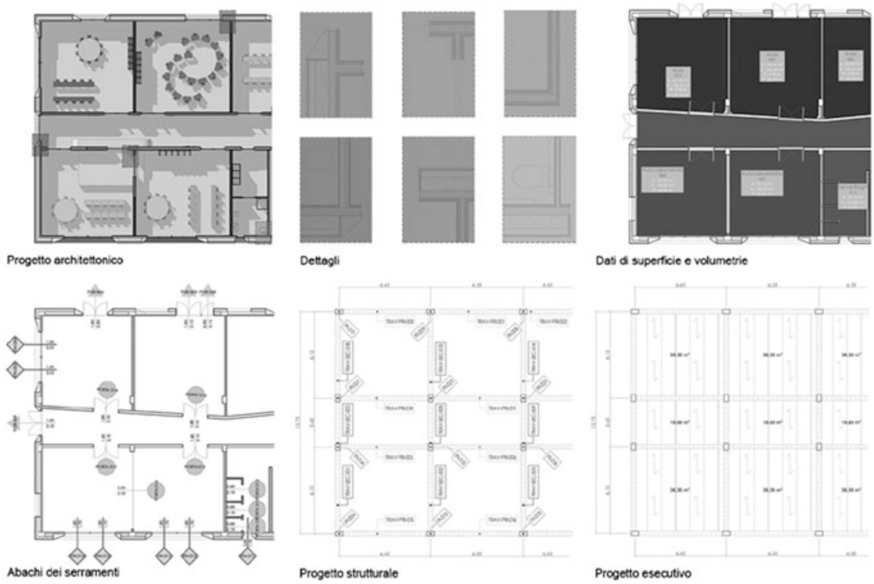

Fig. 2 The coordinated model as a data storage. *Author* Roberto Scalzotto

accounting using the data in the master file. A 5D simulation of the building was made possible thanks to the connection between the metric calculation and the works time schedule (Fig. 4).

A third testing concerns the BIM and the maintenance planning of the University of Trento headquarter in Mesiano (Italy), designed by the architect Gianleo Salvotti (Trento).[4] The possibility of a virtual management of a real building was studied starting from the acquisition of the design original drawings, as well as their check with the status quo survey, in order to ease communication of data and achieve a useful model for following design or maintenance interventions (Fig. 5). The model is displayed interactively and allows you to investigate architecture remotely or through a synchronized on fi GPS connection, isolating the single elements according to the needs, immediately identifying useful information, directly adding comments and notes on accessible to all users model (Fig. 6).

[4]Nicola Ianeselli, *Il BIM e la gestione delle opere pubbliche, Mesiano. La manutenzione attraverso il Facility Management*, master's degree thesis in Building Engineering-Architecture, University of Trento, a.a. 2012–2013. Software: *Autodesk Revit*, *Autodesk Navisworks*, *Microsoft Office Excel*, *Microsoft Project*, *Autodesk BIM 360 Glue*.

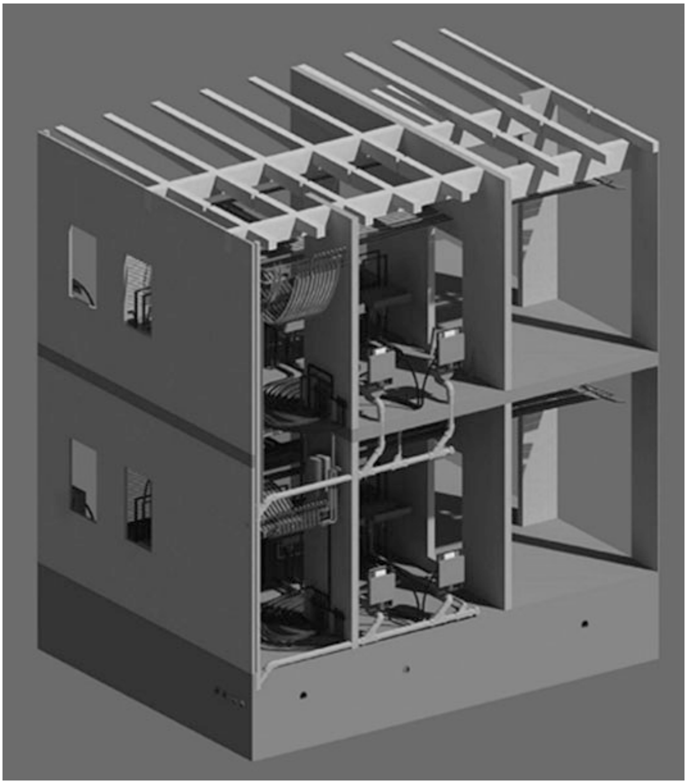

Fig. 3 The architectural, structural and plant engineering model for Clash Detection. *Author* Stefano Colombelli

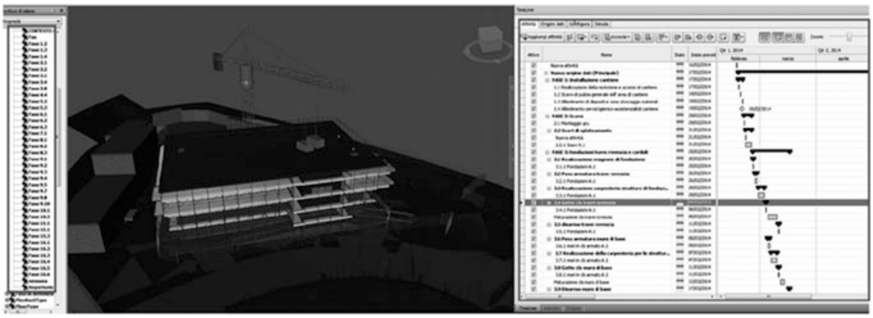

Fig. 4 The 5D simulation of the building. *Author* Stefano Colombelli

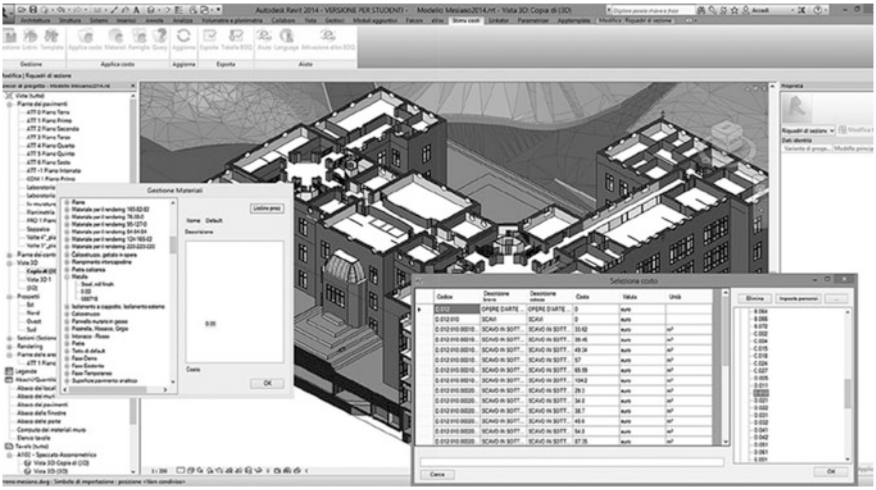

Fig. 5 The virtual management of real building. *Author* Nicola Ianeselli

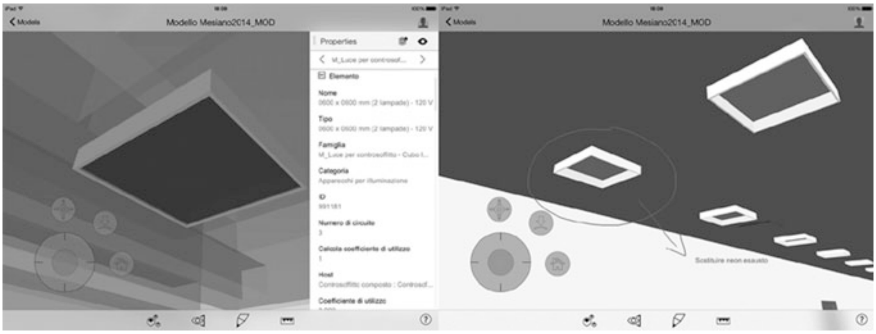

Fig. 6 The interactive use of the model. *Author* Nicola Ianeselli

4 A Case Study: The Rebuilding of Baita Lanzola in Val di Sella (Trentino, Italy). By Lewis Dal Magro[5]

The design involves the re-use of a mountainous area thanks to the restoration of an historical rural building. This building has been transformed in a mountain shelter with horse stable. The main theme of the design is the preservation of the local

[5]Lewis Dal Magro, *Dalla prefabbricazione al calcolo strutturale: il flusso di lavoro BIM nel recupero architettonico di baita Lanzola in Val di Sella*, master's degree thesis in Building Engineering-Architecture, University of Trento, a.a. 2014–2015. Software: *Autodesk Revit Architecture 2015, Autodesk AutoCAD 2015, Autodesk Advance Steel 2015, Autodesk Robot Analysis 2015, CSI SAP 2000 v 17, Adobe Photoshop CS6.*

Fig. 7 Render of the rebuilding design of Baita Lanzola. *Author* Lewis Dal Magro

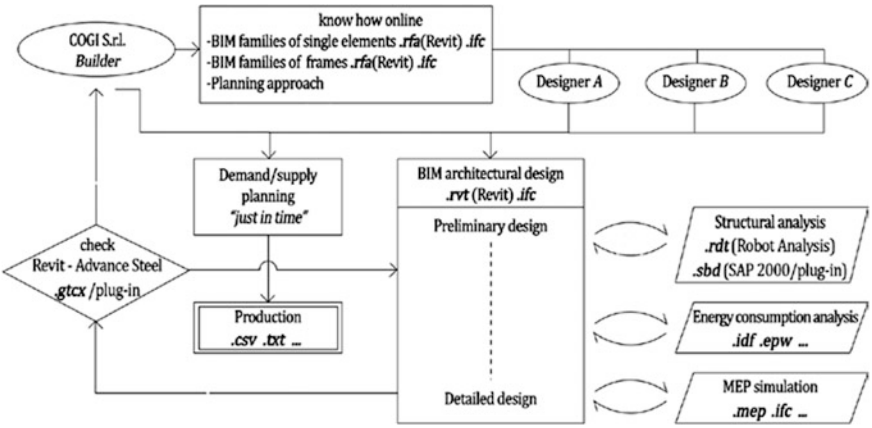

Fig. 8 Integrated workflow assumed. *Author* Lewis Dal Magro

typology of buildings as their forms and technical and manufacturing features by using new technologies and a contemporary architectural language (Fig. 7). Indeed, *SteelMAX*® has been chosen according to the hydro geological assessment plan. This is a new, light and dry structural system made up with cold-formed steel light-framed walls.

This case study has included the definition of a new and integrated workflow which is specific for prefabricated building and is realized in cooperation with COGI S.r.l (Fig. 8). In this way, the choice of BIM technology as development tool has allowed to work out a new design process, that gives the possibility to manage

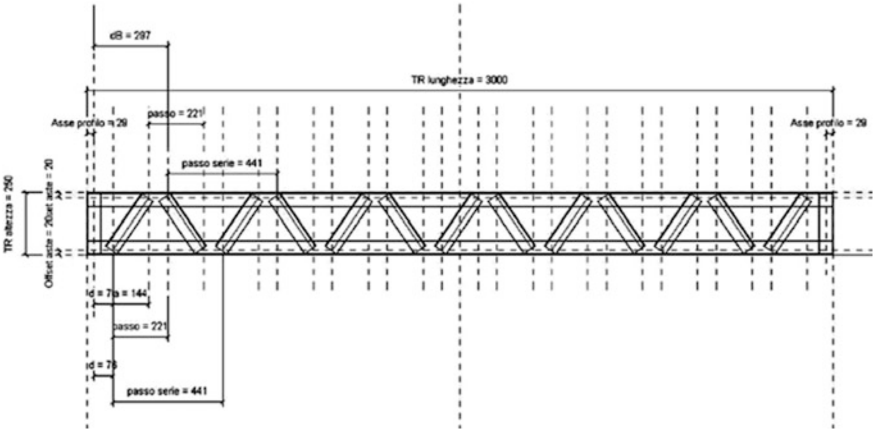

Fig. 9 Geometric parameterization of the steel framed trusses. *Author* Lewis Dal Magro

computations and variances (which occur during the design process or during the construction) in a better way thanks to the automatic synchronization of all the drawings and documents (De Luca Picione and Mottola 2014). This new workflow makes also possible to engage external designers, by providing them with the layout of the frames inside the parametric families. Indeed, thinking about BIM families like routines with parametric rules, which creates the layout of frames for every dimension automatically, means that the designer can easily use some definite structural objects without a specific knowledge of the technology. The families can even include some indirect data as price, weight or critical loads. So, the development of the trusses BIM family together with the automatic positioning of chords and webs at the changing of dimensions (Fig. 9), have showed that BIM can be considered as a database with graphical interface (De Luca Picione and Mottola 2009) and the easiest way for COGI to share the know-how as well as to spread the use of SteelMAX.

The main purpose of an integrated workflow is the optimization of materials and economic supplies without making the design quality worse. However, tests on the possible connections between this ideal workflow and the real possibilities, which are offered by BIM, have had to face up to the interoperability between different software. This new workflow considers architectural design as the main point by using *Autodesk Revit Architecture* as BIM platform and its integrated applications as direct connections with software for calculation, energy consumption analysis etc. in this case. So, the designer would be assisted in the synchronization of all the design aspects by both integrated applications and parametric families.

Moreover, some experiments have involved the compatibility between *Revit* and *Autodesk Advance Steel* (upgraded with a specific plug-in actually used by COGI to interface with CNC machines) to check the possibility of a stable feedback between the producer and the external designers. In this way, both the management of time dimension in BIM (4D) and a real relationship with the producer make possible a just-in-time production and a more detailed industrial planning and timetable of the building site consequently.

Two main software incompatibilities have reduced the real chances of the workflow which is proposed above: the first one concerns the connection between the 3D model in *Revit* and the analytical one which is used for the structural analysis. Some reliability problems have come up in geometric control due to the huge number of structure elements. In order to solve this problem, a new and independent 3D wireframe CAD model has been realized, then it has been exported and analyzed with *SAP 2000*. The second one has showed a partial compatibility between BIM platform and COGI's plugin, which has caused some loss of information, in particular those concerning the right orientation of the cross-section around its axis. This loss is strictly connected to the interface of the plug-in with the CNC machines for cutting and machining the profiles.

Some other tests, concerning the better way in which parametric BIM families can be made up, has been considered necessary in order to have an overview of various possibilities. Different typologies of frames has been modeled by using different solutions and by evaluating them in their feasibility with Revit. In this way, each solution has showed its own strong features relating to specific fields of application. For example, modeling single objects (properly said instances) and regrouping them into assemblies has been considered the appropriate solution for wall frames. Both the irregular geometries of walls and the attempt to use single instances also as analytical entities has led, indeed, this choice. On the other hand, thanks to regular geometries, the construction of families with a strong parameterization, including the layout of the frame with geometric rules, the valuation of the number of connectors, of the frame's weight and of the ultimate load at the changing of its length has been useful for modeling trusses (Fig. 10).

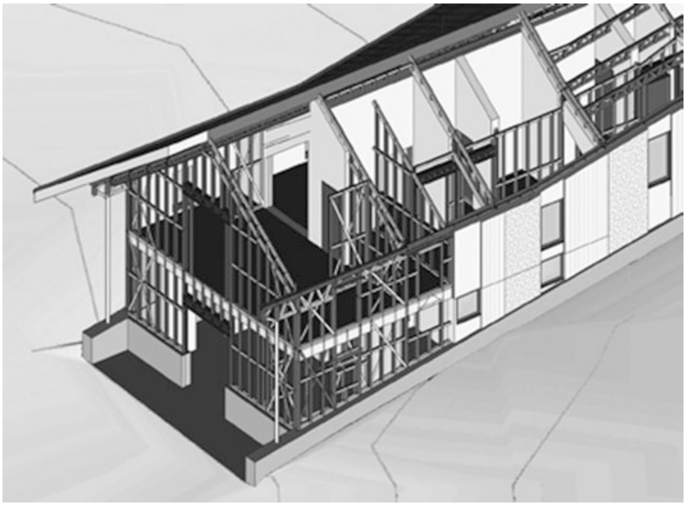

Fig. 10 Isometric cutaway view of structure and finishing. *Author* Lewis Dal Magro

Furthermore, tests on families have allowed to edit complete part-lists useful in carpentries, identification abaci as well as supplies and budget estimations.

To sum up, all the tests on software interoperability and on BIM families have produced an *hybrid* BIM model. Even if the choice of a specific theme, for example the graphical resolution, the part-list editing etc., could have certainly given more detailed results, the main purpose of this case study, as the first one in this specific context, is to provide an overview of the BIM environment, which can be useful to plan future resources. In this sense it has investigated the real possibilities of BIM as a tool with which a complete and integrate workflow can be realized.

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Three Historic Stages in the Graphic Confection of Project Documentation. BIM: Meetings in the Third Phase of the XXI Century

Iñigo Leon Cascante, Fernando Mora Martin, Juan Pedro Otaduy Zubizarreta and Maialen Sagarna Aranburu

Abstract The architectural activity in the construction stage, may be simplified into two distinct phases. On one side is the pre or conceptual phase, and secondly, the realization or execution phase. It can be ensured that there have been three historical stages in how to generate the graphic documentation of the conceptual phase: 1. Pre-Digital stage; 2. Digital stage; 3. BIM stage. It delves into the advantages and disadvantages of each of the three methods, in a comparison of execution times, rates of use of the tool in teaching and its reflection in the educational and professional fields.

Keywords BIM · CAD · Graphic documentation project

The architectural activity in the construction field may be simplified into two distinct phases. On one side is the previous, conceptual o project phase, and secondly, the realization or execution phase. In the design phase, the graphic part is the basis for the development of rest of the documentation, and the part of the project that needs more consultations during the construction development. The use of graphic documentation during the construction has remained unchanged over the years.

All the authors of this communication, are part of the Architecture Department of the ETSASS, and impart classes at the Polytechnic School of Donostia, in the Technical Architecture Degree. Currently we are developing an Educational Innovation Project, which has allowed us to start a research about the introduction of BIM technologies in the Technical Architecture Degree.

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Almost 100% of the constructions are done by reading and interpreting the paper plans in work-site. Nevertheless, the way to generate the plans has undergone major transformations.

The Professors, who are part of this publication, sustain each of their subjects on the basis of a clear and correct graphic definition of the different aspects of the issues imparted. Nowadays, the way to generate the graphic documentation is far away from that was learnt at the beginning of the 90s. Not only has it had a substantially evolution, but also its production has been completely revolutionized. It can be ensured that there have been three historical stages in how to generate the graphic documentation of the conceptual phase: 1. Pre-Digital stage; 2. Digital stage; 3. BIM stage.

In the Polytechnic School of San Sebastian, CAD has been using for generating drawings since 2002. It is used in the Architectural Graphic Expression subject, as well as in the rest of the subjects in which the graphic documentation base is fundamental. At the end of the 2012–13 course, the professors who have written this study, detected that a new trend called B.I.M., was appearing with strength in the construction scene. In September 2013, it was proposed an educational innovation project based on BIM technology.

This project is currently being implemented for the first time in the 3rd course. Architectural Graphic Expression, Projects, Construction and Measurements have been the subjects chosen to share common projects, using a single three-dimensional model generated with BIM technology. The final improvement data, in time, precision and satisfaction in the development of this project are still being collected. The recent study of this new tool, the historical experience of graphics generation in the 90s as well as the teaching practice in CAD graphic production during this first stage of the new century, allows to delve into the advantages and disadvantages of each of these three methods.

1 The Digital Pre-stage

This stage includes the drawing of plans for a Project using hand tools (pencil, paper and pens to delineate, among others). In the 80s, the generation of plans was absolutely handmade and there was no *drawing printing* concept. The plans, which were drawn as artwork, were unique and, at best, they could be photocopied with or without additional scaling. At this stage, the physical material that was needed to work, started by having a table with a large board, to place the paper on which the plan was delineated. But no less important was the possession and use of a wide range of gadgetry (Rodriguez de Abajo and Alvarez 1981). Nowadays, with few exceptions, all this instrumentation is not used any more, nor is it even known by new graduates of the Degree in Technical Architecture.

Both the need of large physical spaces to draw and the technification of the drafter, were handicaps at that time, but the main disadvantage of this stage was the time spent in the generation and editing of project plans. On the regular teaching, in

1990, a student in the first course, in ETSASS,[1] drew during 16 h between Monday and Tuesday. The types of exercises were divided into four parts, one of which was the technical drawing or drafting by hand. Every week one of those four parts was selected to be developed in those 16 h. The same exercise is taken for the time comparison, based on a scale photocopied plans of a famous architect house, such as the Villa Savoye of Lecorbusier. It was nearly impossible for a student to draw the three floors, with all the lines in pencil and delineate them in the corresponding ink thicknesses, in the week that the delineation exercise was developed. However, nowadays, the students of the first course of the Technical Architecture Degree, have 15 h of CAD in the course of Architectural Graphic Expression, and in that period they learn how to use the tool; they are able to develop the two floor plans, four elevations, sections of 2–3 houses, dimensioned and converted in pdf. The difference is really substantial in the execution of the plans, but is huge in terms of their changes. The drawing execution time at this stage could last between 300 and 500% compared to the CAD, whereas the dimensional change in the building perimeter, once the plans were finished, it could assume a time investment of approximately 3000% in comparison to the CAD (CAD 1 h vs. 30 h at this Pre-digital stage).

But not all were disadvantages at this stage, due to the fact that students developed the delineated drawing in a specific and unique scale, and therefore the levels of definition were also specific, and not as CAD, in which often it is drawn regardless the scale in which it will be printed. The line weights were specific, the size of the texts and heights was adequate for the reading, the construction details had only elements that could be delineated and those which were capable for being read at that scale. In the next two stages, these definitions are perverted, by the disorientation that students acquire for not drawing in scale, but with the original size of the object or building, that could then be printed at different scales.

2 The Digital Stage

In 1965 ITEK Control Data Corp. launched the first CAD for a price of US $500,000, but it was not until 1982 that John Walker founded Autodesk, and so it could be created the first version of CAD PC priced below 1000US$ (Gindis 2015). It was in November of the same year when the first version of AUTOCAD at Comdex in Las Vegas was introduced (Avila 2012), but until 14th February 1997 when the R14 version of AutoCAD was released in the market, the digital stage did not replace completely to his predecessor.

The improvement in preciseness and the time savings in execution and modification, which would entail in the drawing development, made it clear that this new tool would be able to bury the previous stage. The first step for the big change came

[1]ETSASS: Superior Technical School of Architecture of San Sebastian.

with the second version of the v12, where the model space—paper space concept was implemented as well as many other improvements, but mostly because it started to run under the Windows operating system. Since then, all the reviewed versions run under Windows, but it was the 13 version in which it was completely integrated into the operating system marketed by Microsoft.

It was stated that from 1993 to 1998, was the period where the professionals consolidated the drawing through CAD programs, leaving apart the classic drawing board (Penttilä and Weck 2006). In ETSASS and in the national scene in general, these periods were delayed slightly. In the late 80s the use of CAD programs was evident, but the Final Degree Project (FDP) presentations, still remained with plans delineated by hand on paper, in most of the cases. Between 1993 and 1998, many Architecture Studios, already had CAD tools for the plans development, but in teaching that period was the time when the percentage of FDP submitted by hand began to be less than those submitted after printing CAD plans. However, still in 1998, at least 20% of the projects were delineated by hand. Including Iñigo Leon's FDP, that had thirty plans delineated by hand in paper, due to the organic form of the building (Figs 1 and 2).

For this type of organic buildings raised from the further evolution of the development of handmade models, the AutoCAD of that time did not even allow to have an efficient answer. That is the reason why, the architect Frank Gehry, after the first CAD design made for the fish sculpture for the Olympic Games in 1992, started to look for a tool that would allow to simplify and to speed both the graphic

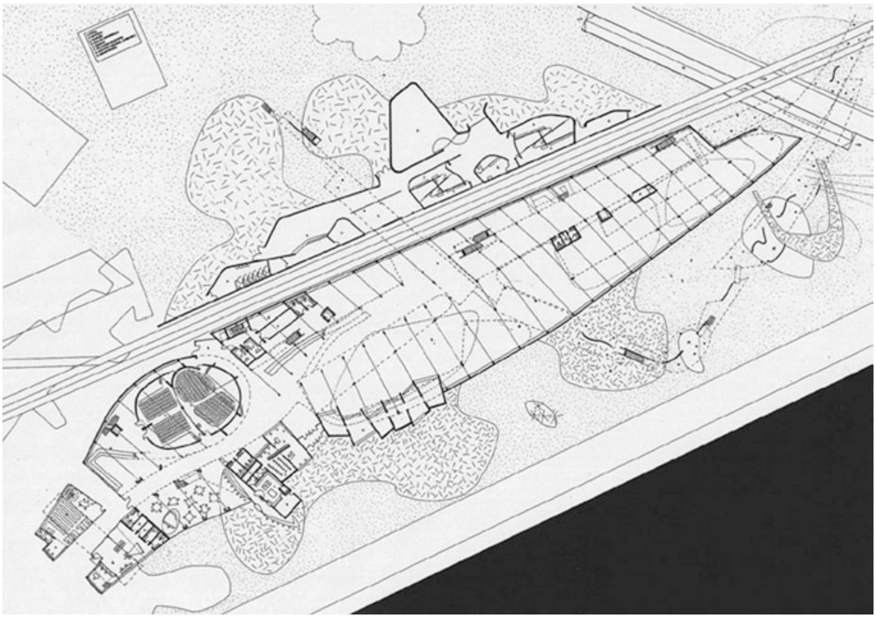

Fig. 1 Floor plan of Iñigo Leon's FDP

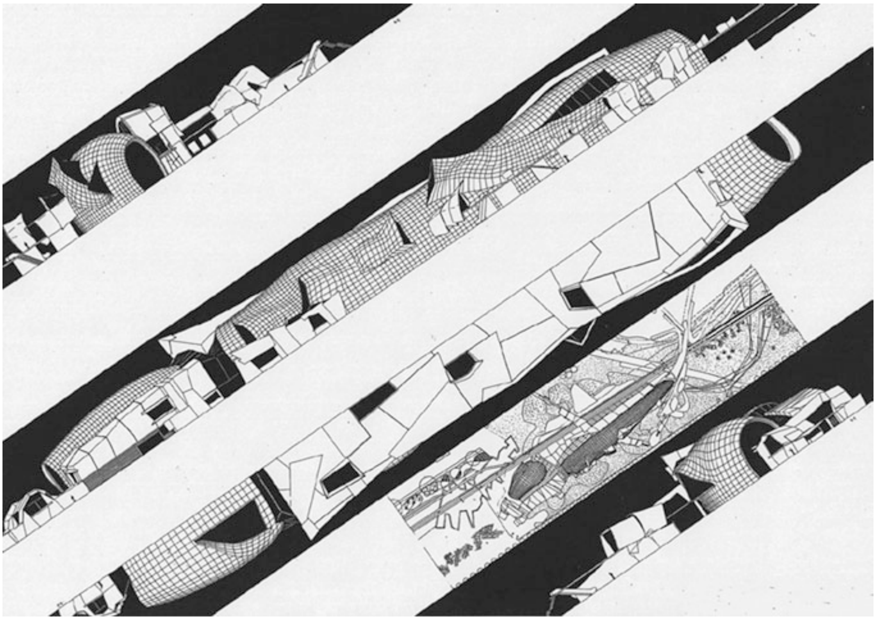

Fig. 2 Elevation drawings of Iñigo Leon's FDP

project development as well as the execution phase. They managed to fulfill their requirements thanks to his partner James Glymph, through an interactive three-dimensional CAD program called CATIA, which was first developed by the French aerospace industry (Evensen 2005).

Concerning the advantages and disadvantages of this stage, must be emphasized the fact that really revolutionized that time in comparison to the previous one, which was the *Undo* command. In the previous stage, a mistake in the delineation, an accident with the ink, or with liquids, could spoil the work of several hours. Since then, any error could be corrected and modified the drawing in one second thanks to a single command.

Concerning the physical space, it was possible to reduce it up to 50%, because in order to generate drawings in the next two stages, it is only necessary to use a computer. In 1993, the newly opened ETSASS had available huge open classrooms full of reclining large format boards. Today, each of those classrooms reaches up to 4 separate spaces divided by screens. It was not only the physical material saving, as at that stage, plotters were began to be used, in which initially feathers or *rotrings*, were placed, with every thickness or color intervening in the drawing. The subsequent evolution of the ink jet printing simplified considerably the problem. One of the biggest disadvantages of this stage was the abandonment of the technical drawing board and its peripherals (with the consequent loss of value) and, furthermore, the huge financial expenses in computers, 19-in. o more screens, software and plotters. The advantages, the improvement in the delineation precision, the execution times savings and, especially, in modification times, until unimaginable limits.[2]

The disadvantage, as explained above, was the development of a plan without having the printing scale in a very precise way. But in the digital stage it was also drawn in geometrical way, so any change still continued to affect to the rest of the plans and, therefore, the possibility of making mistakes remained very high.

3 The BIM Stage

Although there were earlier examples dating back even to 1987, it was not until 2002 when the “Building Information Modeling” concept began to be used, once Autodesk bought the Revit Technology Texan Company (Davis 2011).

The use of this latest technological tool (BIM), both in teaching as well as in the professional market, not only evolves the way to produce the graphical part of a project, but also allows to model, simulate, coordinate and therefore optimize, in the same 3D model, the entire life-cycle of the building. BIM can be used to have connected in the same model, the entire construction process of the building, its maintenance and, why not, even the demolition. In this way and for the first time ever, both the conceptual stage (project development) as well as the execution are linked (Eastman et al. 2011).

The skip from the first stage to the second digital stage was easier to understand and, therefore, it enjoyed of great acceptance. BIM is not only the change of software for developing plans in a more efficient way but also a change in the way projects are created. In this new tool exists a unique three-dimensional parametric model around which many disciplines are integrated and many agents and technicians must be linked, so it requires a change and involvement that has never before occurred in the construction field. All this requires inevitably a collaborative work. With BIM not only 2D drawings are managed but also 3D modeling and rendering, construction scheduling, a new dimension that allows to insert prices in the same architectural model and a follow up of the economic cost of the construction in real time.

Nor plans neither a simple three-dimensional graphical model are being drawn any more. The graphic part is fused with other disciplines and, instead of drawing, it is constructed virtually. The items, that are drawn, have physical properties:

[2]Nowadays, a student of Architectural Technology Degree develops with AUTOCAD all plans of an execution project of a single family house (about 30 plans) and the rest of the technical documentation of the project in 300 h. At best, only the graphic documentation of the same project developed by hand exceeded by far those 300 h. And in those cases of complex constructions as in the Iñigo Leon’ s Project in 1998, more than 1200 h could have been spent for the whole development of the 30 plans.

materials, transmittance, prices, etc. Those properties are stored in relatable data bases that allow to generate all kinds of reports and budgets through pluggins to other programs that are used nowadays. Besides, it can be checked any interference between the architectural part, the facilities models and the structure, before and during the construction. This unique three-dimensional model avoids the mistakes in the plans, since they are corrected during the model design (in any of its views), and this produces an automatic update in each of the project plans. This has a positive effect on the decrease in execution problems and expenses. This process leads to a costs reduction in the project, but especially a performance improvement, reducing the time spent on the project development, since the agents do not participate sequentially, one after another, but they do it in a concurrently way, participating simultaneously, being able to make a collaborative work, thanks to the group participation systems (Hernández 2011).

In this educational innovation project that is being developed, the professors of the Department of Architecture are working in collaborative way, as it is required by this new tool. In at least four subjects of the third course, it has been established the interdisciplinary, transversal and unitary use of the three-dimensional model. This way, students are getting used to this new way of working, in which since the very beginning, the graphic part is indivisible of the construction. We deliberately want to foster the application of the BIM methodology in the architecture and engineering curriculum, by allowing students to experience the benefits of using BIM in a collaborative context, rather than as a mere modeling and documentation tool, as it happened before. Students will learn to work together, to exchange information using BIM models and to apply BIM as part of the design process (Boeykens et al. 2013). In this way, students will be able to achieve competences that are more appropriate to the new market reality. BIM enabling technologies should be integrated into the university curricula, not only as just another set of design modelling and management tools, but as a way to investigate and reflect on the changing nature of the building profession in order to prepare students for these changes (Gu and De Vries 2012).

The Projects and Architectural Graphic Expression subjects boost the activity but Construction and Measurements subjects interact at all times to evolve the three-dimensional model, so that it acquires the necessary parameters for a proper project development. Additionally, the professional architecture Studio NTD has been integrated into the project, so that, the implementation of this technology can be expanded in a national labor market that has just begun to implement this tool regularly. In the sequence, it is highlighted the need to continue with the full adoption of the paradigm through its implementation in the disciplines of facilities, structures and construction. The task, that is currently imposed, is the BIM training of the rest of the professors who teach these disciplines, so they can go gradually introducing the paradigm of these contents, to achieve a full use of these technologies on these components (De Sousa Carvalho and Leão 2013). To Barison and Santos (2011), collaboration is one of the fundamental concepts introduced by BIM, and the integration of different disciplines for use and teaching is required.

In the period that it is been working with the students, it can be checked the potential of the improvement that may be achieved, although two are the main obstacles that are being found. On one hand, the students, that although have knowledge about all the items to include in the model, are not used to have to define everything before start drawing. Sometimes, it is considered as a simple modeler, in others it is used without the needed integration of all the disciplines involved in the production process of the project, characterizing, thus, the detected underutilization. Academic experiences tend to use BIM from a thought that is contaminated (or that derives) of the modus operandi of a logic design under the use of CAD, and particularly of AutoCAD. In other words, it seems that professional partners in the building design process still work in isolation, without using the benefits of BIM system because this technology requires a revolution in thinking and in the way of operating in the academic activities (Monteiro et al. 2012).

The second obstacle is that the tool still contains a number of families that remain being insufficient to cover the entire construction range and besides, the sections have a lack of required construction detail up to scales 1/50 (1/20–1/10) etc. At the current time too much attention is being paid to the ‘quick’ extraction of two-dimensional drawing/representational information. The profession has been leading the BIM charge and in the initial enthusiasm of the movement has not reflected on the potential changes in deliverables and continues to dumb down the building information model to the lowest common denominator, the drawn sheet set (Ambrose 2006).

It has been established some satisfaction surveys among both students and degree professors. Overall, the results of the first surveys made in early December 2015, show a clear satisfaction of the students with new BIM technologies. 90% of them believe that this tool is more efficient than the CAD, due to that it allows to reduce the runtime of the project, since the errors in the previous system are avoided. In the surveys, it has been particularly well appreciated the fact of dealing together various subjects around a unique three-dimensional modeling.

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Drawing Without Drawing

María Josefa Agudo-Martínez

Abstract Parametric modeling integrates both experimental design (CAD) and its realization (CAM) and verification (CAE). It is susceptible generative systems variations and 'mutations', based on parameters that are translated into a programming language by 'genetic algorithms', as the named John Holland in 1970. This raises the possibility to operate, simultaneously, with multiple solutions, for the sake of ideation and prototyping later. These prototypes programmatically parameterized with Grasshopper, may even become smart objects with Arduino hardware microprocessor programming electronic components.

Keywords Parametricism · Digital morphogenesis · Genetic architectures

1 The New Paradigm of Parametricism

The dilemma that arises seems to be trying to elucidate the priority of the hand in front of the machine or vice versa; but it seems that the answer is obvious: because the hand no longer a tool, the quality of the outcome depends primarily on the concept or what is the same, mind and sensitivity guiding hand and/or machine. In any case, it is clear that the new core competency, associated with the control of said end result is programming skills in open source languages, namely, draw without drawing.

Patrik Schumacher Parametricism defined as the great new style after modernism. In his famous manifesto contrasts, for example, the concept of space field, or so the deformation, thereby making explicit reference to a multifaceted reality, but also the dynamism and complexity of today's society. With these new technologies parametric modeling and digital fabrication, in some cases linked to landmark buildings, the aim is almost always the maximum optimization from components of multiple production and easily built using industrial materials of low

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cost, especially with prototypes furniture (Rivera 2014: 244). On the other hand, geometry and art come together in this time more than ever (Cabezas Gelabert 2011: 69), finally overcoming the traditional separation between art and science and a new generative geometry associated Parametricism. Thus, the parametric and algorithmic design, enriches, of unquestionable way his predecessor, descriptive geometry, and does also through research and innovation. In that sense, compared to the metaphor of the drawing board, parametric modeling "it is based on the metaphor of a machine shop" (Cardoso Llach and Capdevila Werning 2009: 138), which means that the generation of the model appears associated with its numerical definition, i.e., the model is defined by a system of relations that allow multiple variations. On the other hand, it is true, however, that the Parametricism not have to be a unified style as stated Schumacher (2009: 14), but come to understand it as an integral approach that caters mainly to economic and functional approaches and not exclusively formal.

In another vein, also from a formal perspective, the curved line and the straight line appears to have been inconsistent in numerous stages in the history of architecture, with sometimes radical positions in favor or against each respectively they. In connection with this, traditional concepts of drawing such as grid, even in the twentieth century architecture (Cortes Vazquez de Parga 2013) or proportion (Padovan 1999: 221) may appear associated indifferently to both types of line, combining tradition oriental wisdom of nature with the Western tradition of rational knowledge (Doczi 2004: 127). In this regard, some brilliant architects have managed to reconcile all times and make the most of each. In another vein, the uniqueness and the uniqueness of images-matter (Brea 2010: 12) contrasts with the specific attributes of other types of images such as incorporating movement (films) or any form of e-images, latter certainly characterized by spectral and ubiquity. Therefore, routinely he used to speak of an antithetical art-technique; although this is, obviously, a conceptual opposition is considered largely overcome today.

This raises a new architectural paradigm, the geometrically ambiguous forms, endowed with a huge formal complexity and indissolubly associated with the concept of digital technology, you might find a supplement with other technological approaches; As an example, in cases of hyper desire, the augmented reality on a mobile device. This new paradigm there also be framed within a global context of crisis of science in relation to obtaining situational or sensory (Burgos 2008: 111), which is, when you talk about architecture, a reinterpretation of the creative processes that also carries with it a surprising component highly motivating pedagogical renewal or revision. Thus, from a general point of view, digital technology occupy a role of maximum importance in the management of production processes and happen to be, now more than ever in the service of human beings in the sense aimed at resolving real or practical problems. It speaks therefore cross tecnociencia I bound performative or collaborative design, the latter based on the use of genetic algorithms or hypergraphs and for generating parametric patterns. On the other hand, the so-called cyberspace appears as a new social telematic stage

(Burgos 2008: 114) requires interaction or active participation of the audience, which changes radically the concepts of space and time in interpersonal relationships, avatars and loaded with new experiences and sensations where the real body is actively involved in this new Noosfera immersive environments. Thus, the three-dimensional Interactive Modeling and Simulation with Virtual Reality (VRML) inquire about the potential telesentidos hand called the pentasentidos. Thus, speaking increasingly ephemeral architecture, with the new concept of event-driven design (DOE), but also with recycled materials or furnishings mutants with 'fluid' or 'evolutionary' architectures in the so-called 'digital morphogenesis' (Kolarevic 2008: 3). It is, in short, learn to build from the crisis and live with the chaos by using exploratory and investigatory strategies.

2 Open Source Versus CAD/CAM

From a global perspective, this new contemporary paradigm appears associated, as already mentioned, the interdisciplinary and collaborative research, and all linked to a general restructuring hand knowledge to a new articulation of knowledge. Thus, the 'death of the author' gives way to architectural or artistic groups that often work with the philosophy of shared culture 'Open Source' and free software, sometimes utopian claim of low cost that 'everyone can be manufactured their own home'.

Ivan Sutherland developed Sketchpad in 1963 as the first GUI computer-aided design (Cardoso Llach and Capdevila Werning 2009: 137); however, the architectural design was able to react only after a few decades. Thus, CAD systems with devices aided manufacturing (CAM) today enable the exploration of new territories; it is provided with greater creative freedom based on new skills certainly they are associated with new ways of digital architectural ideation, all with the implementation of increasingly complex visual grammars. Thus, complex geometric shapes gradually take over the architecture, forcing the discipline to question its specificity, in the search for increasingly efficient, adaptable and flexible solutions. Thus, the concepts of serial module and are supplanted by version and variation. In this sense, the parametric modeling integrates not only experimental designs, but the realization thereof, the latter being one of the main distinguishing features from the methodological point of view. This construction also carries implicit rationalization key issues such as performance or variability, along with other attributes such as complexity and efficiency. It is generative systems susceptible varieties and mutations, which can be tested and verified.

In connection with the teaching of architectural design, today we are witnessing a revision of the traditional teaching model based on 2D drawing prioritarimente (Bravo Farré et al. 2012: 45). This also holds true for many other technical subjects in which an increasingly interdisciplinary and cross-collaboration is necessary. Thus, the (Building Information Modeling) BIM systems begin to gain exponentially, which is a significant change regarding the way of conceiving the architectural design. This is why the analysis and cover the entire project documentation structured in a very basis of interchangeable data, which, being interconnected, enables and encourages interdisciplinary work, which undoubtedly becomes essential. Thus, the traditional concept of drawing is gradually replaced by the 3D virtual model, with the additional advantage of parametric modeling, which is the automatic update of the changes in each and every one of the views associated with the model. This new approach also includes, in the professional field, complete control of the lifecycle of the building, which means that maintenance is taken into account from the project from a more constructive realization almost from the start.

With all this, not only it seeks greater coordination of work teams, based on collaborative models, but also gains in productivity by reducing time, achieving greater control of all aspects involved in the final construction building. However, optimizing BIM model, characterized by an integrated practice associated with greater rigor and precision, without saying which requires an efficient coordination of disciplines and specialists, as well as a much clearer and realistic shared planning. Faced with all the aforementioned advantages, some disadvantages include essentially related to the loss of spontaneity, quality, originality and sensitivity of traditional drawing. Thus, the initial stages of ideation, exploration and sketches, almost seem to disappear at a stroke and completely, or at least be replaced by new ways of understanding human sensory component. Therefore, it is given that good architecture is art and not only priority construction, the experimental component becomes essential, especially during architectural education. This is undoubtedly to interpret the digital modeling and parametric design tools as authentic ideation, much more powerful and versatile than traditional, while much more motivating for most pupils. Thus, simulation and visualization of 3D models from digital tools, involves the integration of the physical variables of the model with other type of construction or location and actual contextualization in one environment (Velandia 2011: 1). It is, in short, a modeling elements that become dynamic, essentially by the permanent possibility of modification and visualization. Among the modeling programs added versatility, the most widely distributed in the field of architecture is certainly Rhinoceros, while the huge potential of Grasshopper (Fig. 1), born as a free plugin parametric modeling, comes to nearly unseat in popularity to the program whose interface is supported; especially for his inexhaustible potential for dynamic elements. On the other hand, another of the great innovations are the CAM processes, which enable the development and cutting surfaces, to enable the production of physical prototypes that promote artistic creation from experimental research (Zellner 1999) Geometry topological non-Euclidean (Lootsma et al. 2004).

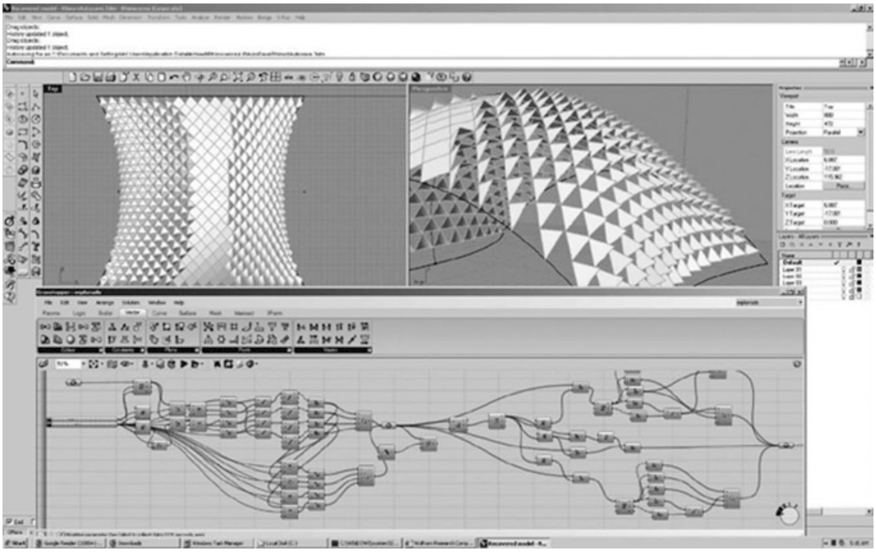

Fig. 1 Programming with Grasshopper

3 Genetic Algorithms

Faced with the linearity of traditional design, the power and the possibilities for parametric design, characterized by its greater complexity, enables greater flexibility and capacity for experimentation and innovation (Morales 2012: 3). So, from trees logarithmic equations of mathematical relationships that produce a qualitative control by allowing all parameters involved in the model definition, thus saving time and avoiding repetitions allow easily introduce variations in the process of establishing jump Formal ideation. In this sense, the novelty lies in the emergence of a new paradigm associated with a new methodology and it basically involves moving search of a static and only working with families of infinite possibilities formal model. However, while the advantages of this new methodology and the potential of modeling software are, obviously, unquestionably, the creative process and design functionality appear to remain priority or essential issues. In this sense, it is essential not only consider the historical context of the building, but above all to respond to real needs of potential users.

This new geometric design from parametric algorithms (Rivera 2014: 246) requires a reflection on a multicultural contemporary architectural design. The same is also associated with new formal possibilities of digital technologies and therefore has new patterns of hybridization based research and heterogeneity; thus culture, science and art mix, through a network of interdisciplinary and cross interactions. All this with a growing interest in corporeal a multisensory experience based on logic, which come into play all the factors of the environment (Pereyra 2013: 1). It is inspired by biological processes (genetic algorithms) designs, but with concern for local concepts as identity and tradition, in the sense of adaptability to specific needs, consistent with the complexity of human behavior and significant relationship of architectural space (Pirela 2013: 36). On the other side, and so imperious, also it seeks to be consistent with sustainability approaches in relation to the earth's resources. The new virtual models often take hold of biology, based on parameters that are translated into a programming language by 'genetic algorithms', as John called them the possibility Holland in 1970. This raises operate, simultaneously multiple solutions, for the sake of ideation and prototyping later.

Furthermore, the label of genetic architectures is associated with processes of geometric innovation produced in the last two decades and are based on programming codes that allow the control parameters using algorithms and variables, hence the label of generative design, which refers to the possibility of modifying these variables. This applies, for example, with curves and NURBS (non-uniforrm rational B-spline) surfaces derived from Pierre Bezier splines, clear example of mathematical representations of 3D geometry. Furthermore, Grasshopper essentially functions as an editor algorithms, open source, from components connected by wires, which allows the manipulation of variables. This enables the generation of evolutionary structures characterized by a progressive growth that is associated with the methodology of work of the program. This is how the concept of metadesign, which results in the possibility to obtain different designs from introducing mutations in previous projects that can be reused.

They can cite some names pointers architects in this new approach, such as Greg Lynn or Lars Spuybroek, the latter researcher besides the relationship between art, architecture and information technology (Spuybroek 2004) and chief representative of the Dutch architectural office NOX (NOX/Lars Spuybroek 2015). Spuybroek no doubt oppose the new digital technique diagrammatize traditional analogue technique sketch or sketch; it is a 'clean' technique especially characteristic, in his own words, based on parametric and nonlinear interactions between components in interconnected systems modeling. In this regard, experimentation and innovation take place mostly during the search process, a stage that happens to become defining moment that characterizes this new methodology, which also requires prior knowledge of the software used.

4 Liquid Modernity, Robotics and Home Automation

This new 'liquid modernity', as Zygmunt Bauman, is replacing old concepts by new discourses and paradigms articulated around the fluid modeling, with a greater harmony between nature and architecture and a new way of interpreting is postulated the world from non-Euclidean spaces characterized by dynamism and change in the purest tradition futuristic.

Something similar happens with hand and machine, both with both supporters and detractors at all times, as if art and pragmatism were systematically antagonistic questions. Linking with this, there is almost a firm belief that reason and function always go hand in hand (Gutiérrez Mozo 2013: 128). It is perhaps for this reason that the drafting machines seem traditionally been reconciled better with the straight line, which however may in some cases conflict with certain artistic practices such as gestural automatism of abstract expressionism or PLCs Jean Tinguely (Cabezas Gomez and Molina 2012: 453). On the other hand, we must not forget that Le Corbusier emphasized that 'les machines travaillent in collaboration intime avec l'homme' (Corbusier 1958: 231), which translates to accept that the progress of humanity walks the hand of technological progress. However, the revisionist role of art and science is, undoubtedly, to raise new interpretations, sometimes even with the need to redefine concepts traditionally tight. They can be cited as examples of the above artists such as Bruce Nauman, to raise the vacuum as mass (Bruce Nauman: The True Artist 2014: 71) or Gordon Matta-Clark 'chopping' ruthlessly buildings (Sentís 1994: 8).

Returning to Le Corbusier, in addition to its fifty year anniversary, his machine à habiter becomes now more than ever, in an increasingly credible possibility with home automation, but also with a robotized architectural production. This proposal is to make a real revolution in the materialization of architecture in structural design and formally complex and innovative, but functionally efficient. It is, in any case, of novel approaches, albeit with enormous potential to transform the construction processes. New conceptions of the human habitat are, on the other hand, the modular response or multiplicable design, the aforementioned low-cost or low cost. Based on this idea are some examples of innovative architectural claddings understood as devices provided with light and sound sensors and activated from a Arduino (Fig. 2) plate, and respond in different ways depending on the proximity of the user. It is based on established by way of responsive skins and defined as smart objects endowed associated with a Boolean condition of opening/closing movement cells and therefore able to react to environmental stimuli (Pereyra 2013: 2) designs. Examples of prototypes digitally parameterized modeled programmatically with Grasshopper but closely related to other areas of increasing interest as robotics and automation (Chiarella 2014: 439), mainly associated with proposed new construction processes and sustainability.

Fig. 2 Arduino UNO (hardware microprocessor programming electronic components)

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Barcelona and Antalya. Cartographic Analysis of Two Mediterranean Cities

Antonio Millán-Gómez and Zeynep Birgonul

Abstract Cartographic analysis provides a wealth of information when original sources are subjected to scrutiny with ITC tools. The cities studied here, on opposite shores of the Mediterranean, apparently different and supposedly incomparable morphologically, exhibit some akin structural traits. They interest us here, to evaluate the systems inherent to their performance. Both cities evolved from a small nucleus and have strong geographical links and exchanges with their peripheries, and grew from an industrial and historical background to a varied economy, in which its touristic coastline certainly shows. The tools applied, derived from Syntax techniques, as originally developed by Hillier and Hanson (1984) and their UCL colleagues, enable a revision of spatial networks qualities.

Keywords Urban morphology · Mediterranean cities · Cartography · Urban spatial analysis · Space syntax

1 Introduction

Space Syntax techniques—developed by Prof. Bill Hillier & Prof Julienne Hanson and colleagues at The Bartlett, University College London—help us in the analysis of cities and their morphologies. They were matured after 1984, comparing patterns of movement, density, land use and land value, urban growth and social differentiation.

For this task we use the Depthmap multi-platform software, originally developed by Alasdair Turner from University College London, recently improved by Tasos Varoudis as Depthmap X, starting from diagrammatic Axial Maps that unveil relations in any settlement.

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Both cities studied evolved from a nucleus, around which grid structures with varying densities expanded parallel to the coastline; and in both cases geographic and historical conditions fostered current patterns of activity.

Barcelona was pointed as the grid with highest performance (together with Santiago de Chile and Chicago) amongst 40 cities worldwide, owing to its nature as an open matrix of exchanges, a diversity of systems in continuous interaction. Out of the three alignments that affect the original settlement at a global, territorial or local state (i.e., the Pyrenees, the central Catalan depression and the coastal chain of mountains), the latter determines exchanges (Vilar 1986; Millan-Gomez et al. 2012).

This metropolis is a didactic example to examine links between spatial evolution and planning criteria. Some simulations led to comparisons between alternative morphologies to understand its three growth phases: "an emergent product of a bottom up spatial growth, which is distinguished as the organic grid of the old city. The second growth phase has been also initiated by imposing a uniform grid in a top down planning concept laid down in 1859. The building of this uniform grid called the *Ensanche* has taken place around the year 1891 and has been conducted in parallel to a third type of growth process. This process might be recognized as the natural growth of the suburban town centres which happened to be close to the periphery of the suggested uniform grid. The Current Spatial structure of Barcelona is a result of the intertwining between the old city, the emergent suburban growth and the pre-planned uniform grid." (Al Sayed et al. 2009).

At the Anatolian South coastline, several interconnected cultures were the cradle of successive civilizations. Antalya is an ancient city, close to heritage pieces and built from B.C. 10 century. The area became recently a hectic tourist resort in the Turkish Republic and the Mediterranean coast, with a record of 12.5 million tourists passing through the city in 2014 (Çetingüleç 2014), evolving from an emergent city, with industrial and agricultural roots. A rocky plateau elevated 35 meters over sea level explains why modern traffic goes through this sector. We perceive inorganic urban formations aggregated individually among the geographic elements. The urban tissue shows how similar assemblages fuse with time into an organic fabric. The diagram of connections is clear: strong lines at this plateau, a collection of clusters close to sea level and still inorganic, scattered settlements at the shallow core.

2 Methodology. Syntax as Cartographic Analysis with Depthmap X

Our work sequence proceeds connected areas in the network to detect those that remain busier (integrated) over the years, linked to the through ways chosen by most people, and contrasting with the alternative routes chosen to move towards all sectors.

3 Barcelona, Spain

City center limits: 100 km^2
Surrounding area: (Barcelona + Badalona + Hospitalet D'Llobregat): 134.67 km^2
Metropolitan area: 803 km^2.

4 Antalya, Turkey

City center limits: (*Muratpasa*): 92 km^2
Surrounding area (Muratpasa + Konyalatı): 656.4 km^2, metropolitan area: 20.815 km^2.

Settlements can be described by axial maps with "the minimal set of the longest straight lines of unobstructed movement that crosses and interconnects all open spaces in the system (Hillier and Hanson 1984)". Such lines constitute secondary graphs developed from standard primary graph representations. The first operation is to unveil the pattern of connectivities and their number, or node count, in these graphs, indicated by dark grey colours for high values and light grey colours for low values (Fig. 1).

Second-order measures (the intelligibility of the pattern, or correlation between connectivity and integration) and synergy between local and global scale provide information on how the different states are counterpoised.

Circulation is channelled through Gran Via in Barcelona, its longest segment, helped by Av. Diagonal and two diagrammatical axes (Meridian and Parallel). Here you can see them complemented with the throughways in Badalona, showing a gap that invites completion.

Antalya's map is an *imperfect grid*, with several patterns related with dispersed urban nuclei and the main circulation lines that adjust to areas within the territory. The highly circulated roads at Antalya, 'Gazi Bulvarı' and 'Hürriyet Caddesi', are connected to each other and act as main arterial road.

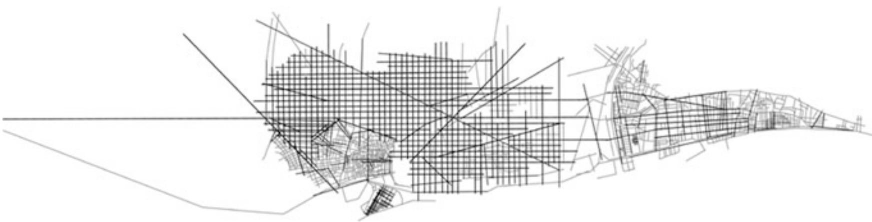

Fig. 1 Barcelona connectivity

The simulation model we follow operates with dichotomies (static and dynamic, local—immediate neighbourhood—and global properties constructed with all vertices) to provide a model to obtain measures for analysis, with basic notions: connectivity, integration, control and choice (Turner 2004).

The basic local static measure is connectivity: "total number of nodes at radius 1", how many other lines are only one step away from each line (i.e. immediately connected to it). The system of study reaches a critical point when density diminishes.

The "global dynamic" measure is "choice": 'how likely a location is to be passed through) on all shortest routes from all spaces to all other spaces in the system' (Hillier et al. 1987). *Choice* may be a better predictor of movement for "inhabitants" with better knowledge of the layout than for "strangers" who rely on reading the layout, in order to move around.

The global state measure is integration, that indicates how many other lines are up to n stops away from each line and points at graph general structural qualities (Blanchard and Volchenkov 2008). Approached by many authors, it is "the degree to which a space is likely to lie on the shortest routes from all points to all other points in the layout is not an intuitable property of the layout, whereas the number of steps a space is from all other spaces is an intuitable property in that knowledge of it can be built up over time by moving around the layout". Integration leads to intelligibility, and intelligibility 1 leads to a stronger "movement interface" between inhabitants and strangers" (Hillier 2002, 238). Segment count is the strongest component of the integration measure with restricted radius and Node count is trascendental, since it suggests activity levels and, though it may seem paradoxal, "*In a significant sense, least angle or topological integration measures contain more useful metric information than their metrically weighted versions*" (Hillier et al. 2007). This fact leads to compare topological integration with different radius in the cities studied. A system of "urban villages" was implicated in Barcelona from its origins, with themes such a renewed paradox of centrality: having provided impetus for its growth, it has to be re-interpreted.

Second order measures in the form of Pearson product moment correlation coefficients (r) convey added information: *intelligibility* (correlation of connectivity and integration) indexes the degree to which the number of immediate connections a line has are a reliable guide to the importance of that line in the system as a whole. Concerning movement, correlation between integration and choice indexes the accessibility of a space as destination from all others and the likelihood of being a shortest routes destiny from all points to all other points in the layout. It shows the agreement between a space's potential for to-movement and through-movement.

Pervasive centrality is extended over both settlements, even cores out of which each city grew, generating a shallow, permeable structure. Both cities show a nucleus and an expansion towards the coastline with dense, highly connected sectors. Line graph analysis does internalise the geometric properties of space into the graph, thus picking up "the nonlocal, or extrinsic, properties of spaces that are critical to the movement dynamics through which a city evolves its essential structures. Nonlocal properties are those that are defined by the relation of elements to all others in the system, rather than intrinsic to the element itself" (Hillier 1997). Since human activity must be developed on oriented surfaces, the primary graph representing the physical network must be planar ("a graph is planar if, and only if it has a combinatorial dual" according to Whitney, as Harary 1972, 115 collects). Planarity affects settlements and representations, and duality must be considered in other senses: secondary graph representations are often not planar, requiring simplification and agreements with social networks (Figs. 2 and 3).

One may perceive a high similarity between integration graphs concerning integration [HH] R3—local value—' and 'integration [HH] R1000—global value —', in both cases. The range leading from city centres to the outskirts is highly integrated at the centre of Barcelona and more dispersed in Antalya, with the exception of the old city 'Kaleiçi'. Actually, the old city in Barcelona and the core of Antalya graph, also near the port, show counterpart measures, and a comparable historical, social, and urban metamorphosis phases.

A second point is that, since Barcelona values are high in the expansion produced from 1860 onwards, compared with those of Antalya, the differentiation of the local-global range is more noticeable in the latter. Owing to extensive planning, the Barcelona grid is more effective than the dispersed grids of Antalya.

Fig. 2 Antalya connectivity

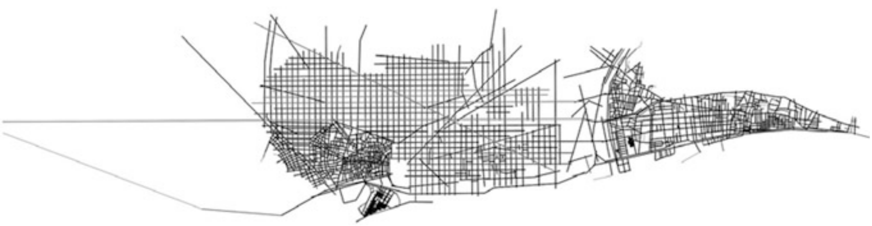

Fig. 3 Barcelona Integration [HH] R3

For that reason, the variation of values is higher for metric measures in the global graph of Antalya than in the similar case in Barcelona, inasmuch as a regular grid spreads evenly, whilst an imperfect grid concentrate integration in those areas of opportunity at the expense of the rest (Fig. 4).

Intelligibility, measured here by means of scattergrams as correlation between *global integration* and *local connectivity* informs that the high values [R^2] in the Eixample diminish quickly, when less connected areas—such as Badalona and the areas around the river Besos—(Barcelona—R^2: 0.26835; Antalya—R^2: 0.0388641). In the case of Antalya the mean depth graph shows how the seashore and touristic activities are located in clusters close to little ports and strategically close to the airport (Figs. 5 and 6).

Topological and metric measures, at local and global radii, show matching values in both cities, with better discrimination in the topological readings (those on the left hand-side). And their (regular or irregular) grid patterns exhibit strong areas close to the sea, observing that the range between city centre in local degree has highest mean depth when compared to the global degrees; when the scale grows, depth also does it, but not mean depth, since most of the activity is located is a band near the sea. This clustering in Antalya contrasts with a straight coast line front in Barcelona, as we could already see in the connectivity graph.

Fig. 4 Antalya Integration [HH] R3

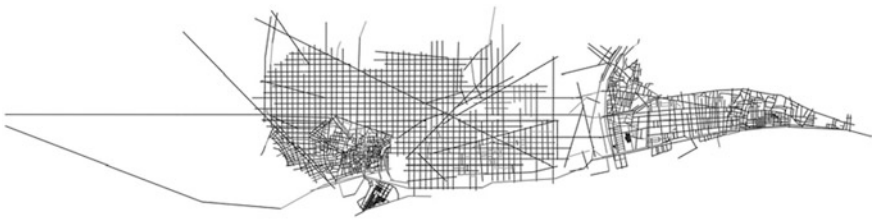

Fig. 5 Barcelona mean depth [connectivity weight] R3

Fig. 6 Antalya mean depth [connectivity weight] R1000

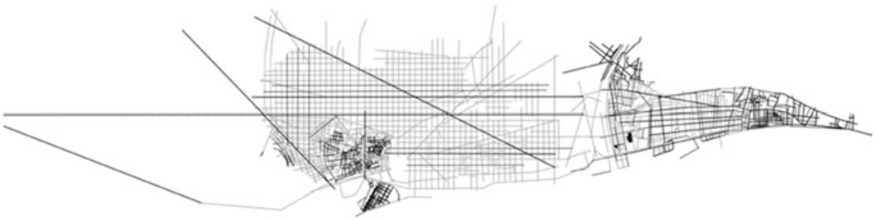

Fig. 7 Barcelona choice [conn. weight] R3

Synergy values (corelation between local and global integration) are dissappointing (Barcelona—R^2: 0.26835/Antalya—R^2: 0.629967). In fact one is left with the impression that a new reading, without a hurry, is required. The steepness of the line in scattergram shows a thinning of node count in Barcelona, we can see a ribbon, not a complete cloud of values, as is the case in Antalya. The different colours show sub-sectors that can be further studied, when separated and studied locally.

Finally, a comparison of the alternative routes characteristic of the movement-to, unveiled through Choice. The two Figures of Choice in Barcelona are quite different, when neighbouring Badalona is added to it. Diagonals are enhanced in Fig. 7, corresponding to the most local topological configuration, that is, with radius 3, and a considerable gap in the location of river Besós and the sporting port nearby. As it stands, one would state that most of the movement is West-bound, in contrast with What appears below (Fig. 8), where darker lines in both senses—parallel and perpendicular to the sea shore, as well as interior axes recently developed, all tell us that some incipient activity is developing in this area (Sant Martí Provençals), even fostering stronger relations between both cities. The inclusion of Badalona in the metropolitan area of Barcelona clearly demands some ties between the established fabric of the city and the newly added segments. Here as in many other instances, determination is fundamental if one wants to achieve planning success.

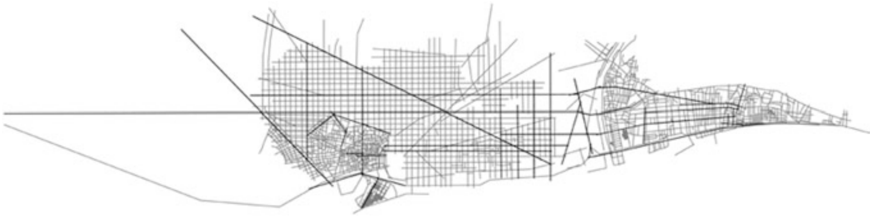

Fig. 8 Barcelona choice [conn. weight] R1000

Fig. 9 Antalya choice [connectivity weighted] R1000

The cycle that appears slightly darker in Antalya (Fig. 9) is a natural throughway that enables to go from the coastal sectors to the upper areas in the city, but, at the same time it is a complete linkage of diverse areas, providing a general reading, and the chance to choose between several w-bridges in search of a most economical short-cut to speed movement. Quite surprisingly, locality seems to be developing with ease, providing a promenade between centralities. Whatever the outcome might be, we are left in both cases with a deep sense of curiosity about phenomena to come.

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Tracing the *Form-Place*. Three Case Studies that Reveal Architecture as Interwoven of the Social and the Territory

Susana Velasco Sánchez

Abstract Based on three case studies of proto-architectures—self-built and immersed in different contexts—and their drawings, this article focuses on architecture as a mediator between the social and the territory. The aim is both to value the quality of these architectures "without architects" and as supplying new clues about the relationship between architecture and context. Drawings are here used both as a transcription of shapes and structures and as hermeneutic procedure which allows us to identify the potencies within the cases. The research is trying to collect signs for a new sensibility in which drawing and building (two actions that pass through the body) function as a gateway to sustainable forms.

Keywords Form-place · Drawing · In-between

1 Introduction

Based on three case studies of proto-architectures—self-built and immersed in different contexts—and their drawings, this article focuses on architecture as a mediator between the social and the territory. The aim is both to value the quality of these architectures "without architects" and as supplying new clues about the relationship between architecture and context. Drawings are here used both as a transcription of shapes and structures and as hermeneutic procedure which allows us to identify the potencies within the cases. The research is trying to collect signs for a new sensibility in which drawing and building (two actions that pass through the body) function as a gateway to sustainable forms.

The theoretical framework of the research gathers, on the one hand, the narrative of the "primitive hut" made by Joseph Rykwert (*On Adam's House in Paradise*, 1973) who has explored the origins of the action of constructing—both symbolic and material—in order to analyze their influence in modern times and to rescue

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certain potencies to our present. From Rykwert work we signalize how he demonstrates that the "primitive hut" can be read as an action, and his proper place lies in the bosom of communities (Rykwert 1990, 14). On the other hand we approach the architectural tradition based on the 'tectonic' that originally from Semper (*The Four Elements of Architecture*, 1850) and Botticher (*Hellenic Tectonics* 1844–1852) reaches our time in the hand of Frampton (1990) who positioned it as the guarantee model of resistance to disasters progress. Alongside the basis of 'tectonic' made by Frampton the investigation retrieves the notion of *form-place*. Another critical line to gather is the one whose objective was to study the architecture "without architects", a matter formally inaugurated by Bernard Rudofsky at the MOMA great exhibition in 1964, an issue that today we could connect with certain voices announcing the need for architecture to open to a new sensible. Is Juhani Pallasmaa one of the present references in this search of a new tactile and peripheral sensitivity (in texts such as *The Eyes of the Skin*, 1996 Animals architects, 1995 and Thinking Hand, 2009) which affects the way we perceive, how we draw and how we move or build.

2 Form-Placer and Form-Product

The *form-place* concept was proposed by the architecture critic Kenneth Frampton at the "Seven points for the millennium: An ultimately manifesto", a notion referred to the form and place junction and at the same time confronted to another form, the *product-form*, notion defined some decades before by the architect Max Bill to refer to "the ways determined by the methods of production employed in its constitution" (Frampton 2000). Overlooking the emergence of a new paradigm Frampton proposed to recover for architecture the *form-place* bringing topography as a defining component of the work with the milieu, referred not only to the contact with the ground but also the covering system, the openings to the territory and the air circulation. The pessimistic mood with which the critic has been analyzing the ultimate paths of architecture finally finds in this notion a way to cope with the progress impact since—according to him—"*form-place* has the capacity to resist the homogenizing trend of universal technology" (2000).

These two concepts provide two ways of approaching the construction issue. We can today verify how the *product-form* has been gaining ground to the *formplace*. Even the differences between them have been expanded and part of the original meaning was gradually lost since the basis of that "good form" defined by Max Bill (on the exhibition in 1949 and then in 1957 in the book *Die Gute Form*) are not exclusive consideration of isolated objects but they showed how "good form" sought equilibrium with the environment in which it was born. From that 50s decade the industrialization process of architecture, in order to improve the overall quality, has divided the construction issue in multiple products that can be controlled independently. Forms are no longer born from the place but they are now imported from outside and the consequence has been the uprooting from the social and territorial hosting context. It is easy to notice how the architecture is today a product made from other products that have become part of the outsourcing tendency of everything that has to do with life and care which by pretext of improving quality imposes the expert logic, expropriating each of the powers that humans have acquired. Neither matter around us neither our hands create today bounds with the place. In this context architect is no longer a figure of interwoven between materials, society and territory but a manager of the new merchandise. But architect is not a figure that can be considered as a victim because with his desire to become an expert started the process that has been expropriating the capacity they had human's communities to inhabiting the world through building it.

3 Three Proto-Architectures Case Studies[1]

This research has relied on the study of three case studies which have an explicit and intensive relationship with the territory. The notion of *form-place* in them does not work as a metaphor but as material bound between the forms of architecture and the environment traced by its inhabitants-builders.

They are three different nature artifacts whose architectural form is a result of social and territorial forces that occur in their coordinates. We can see them as three ways of observatories with spaces that refer to three archetypes: the tower, the cave and the theatre. Each of these artifacts works in a different way with the environment: (1) rising and interweaving with trees. (2) piercing and deploying in the field, and (3) enclosing a space and projecting outside landscape inside. Compared transcripts shown in Fig. 1.

The first case is a hunting artifact, it is known as the *palombière* and it is one of the more than ten thousand hunting huts hidden in the southwest forests of France. These cabins deploy a cable network that connects with the surrounding trees creating mobile devices system to attract birds. Their structures have been installed along years in the tops of trees and serve as a escape for some citizens, who rise them also to open exception times to encounter and live out of the common. It is a case full force today as a sign of an immemorial and atavistic call that continues to push the human to the encounter with nature forces.

[1]About this tipologies a more extense research can be consulted in VELASCO, Susana, "Agujerear el mundo. Dibujos de un Grand Tour por cabañas, cámaras y trincheras" *Palimpsesto* XI. Octubre 2014, 2 pages, and two other congress communications:

(1) VELASCO, Susana "La construcción salvaje. Un caso de estudio: La Palombiére" Congreso de sostenibilidad, Encuentros Internacionales, CONAMA 2012, (2) Congress Communication: "*Red de trincheras en torno a Madrid. Un patrimonio desconocido de 100 kilómetros de arquitectura, ingeniería y paisaje*" at the congress: PATRIMONIO, TERRITORIO Y PAISAJE. JORNADAS INTERNACIONALES DE INVESTIGACION (Tercer foro internacional de las ciencias en ámbitos antrópicos). 2013. Departamento de Arquitectura, Escuela de arquitectura. Universidad de Alcalá (España).

The second case is a war artifact that unfolds within the territory; it is the trenches network that was opened during the Spanish civil war. A net of shelters and defences in complex geometries drilled on the land along the frontline that crosses the country. As well as a war machine it is also an habitat structure for the struggle time. Such an operation has left its visible traces on our topography and it allows us today to access a sort of reinterpretation of the landscape through these traces. It is an operation from the past time but is charged of historical significance today, since after years of oblivion these landscapes have begun to be walked through as visible signs of a time in which life had a political attitude and was linked to the struggle.

The third case is an artifact that works with images. It is the phenomenon of the camera obscure. A mechanism which aim is to provide a closed space amid its milieu, bringing it to total darkness to open small holes which allow entering beams of light that unleash an optical phenomenon: the projection of images from the surrounding landscape into the interior surfaces. In order to study this last case we have run a prototype in a particular landscape. The drawings transcriptions therefore correspond to the *Cámara Solar del Santo Isidro* that we raised collaboratively with neighbours in Herreruela de Oropesa in 2009.

This triad of cases seek to address the issue of architecture and context. The research tries to understand their similarities and their differences. Among the similarities the main one is the fact that the three artifacts are centred on an operation that polarizes them: opening holes in its envelope to fire a weapon, observe the exterior or to hunt the outside an image. These holes are canalizing the network with the territory, opening visuals, bundles or cables that link architectural form to the peculiarities of the environment. Creating a geometric and material connection between the variables of the outer and the inner surfaces and uses. Furthermore the nuclear spaces from the three cases are similar in scale, they have a cockpit to manipulate the artifact, which is built in human body measures, in distances between two and four meters. These three cases arise on society in conditions of self-building by its inhabitants.

To establish the differences a list of variables is detailed: (Table 1) the materia with whom they work, the operation performed in the space, the mythical figure to which they refer, and the limit they explore Those variables inform us from the unique way in which each artifact is tied to territorial and social context.

A last drawing operation was performed to understand the whole of its similarities and differences. The following graph (Fig.2) shows a successive superposition of the three sections. The similarity of the cockpit operations measures allows us to establish a common horizon match so that we could observe the spatial movement that each one performs. This shared horizon allows us to observe a floating line as they are able to partially submerge in the matter of land or rise above it. In that superposition we can notice complementarities between the three generic operations of rising, digging or enclosing which also correspond to three archetypal figures, three mythical topos overlapped: the tower, the cave and the theatre.

These drawings function as a result of the experience that one have when enterins into these spaces and at the same time works as a method to reveal

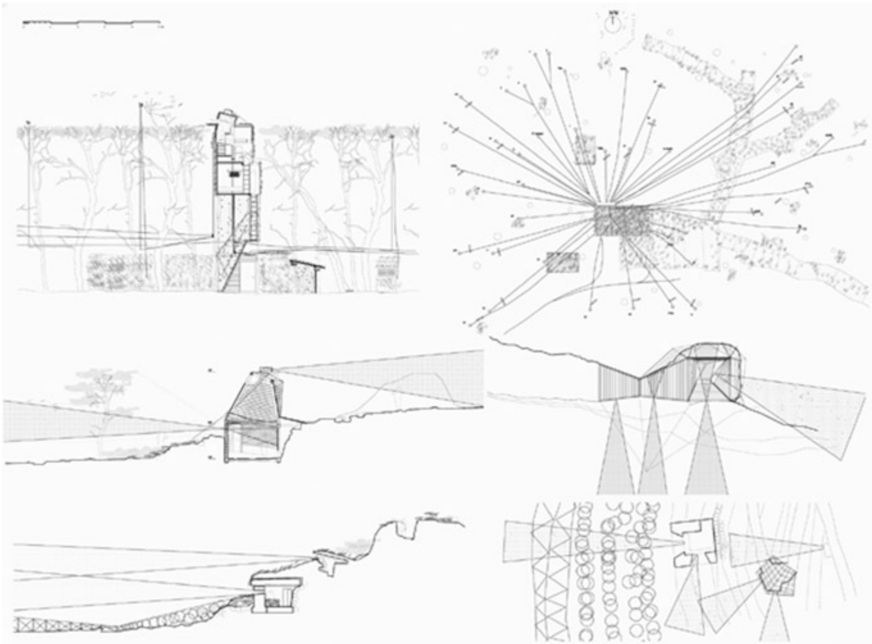

Fig. 1 Transcription drawings from the three proto-architectures (*palombière*, trenches and cammera-hermitage in Herreruela). Sections and compared

Table 1 Attribute matrix of the three case studies

	Matter worked	Space operation	Mythical topos	Limit explored
Palombieres	The air	To arise up	The tower	The wild
Trenches	The earth	To dig	The cavern	The struggle
Camera obscure	The image	To cloister	The theater	The representation

non-apparent qualities. So that experience and drawing share some characteristics, the first one is that the body who crosses and the constructive elements are composing together in a relationship of equality, due in partly because mark gestures from the builder hd left a corporeal quality, both in measures and in the way elements are assembled. It can observed corporal attributes in these architectures, and opposite to the usual distinction between figure and background we find here a kind of sympathy between body and envelope. Because it is the body that ventures into them who adapts itself, folding, raising, lowering or operating mechanisms to advance inside, it is a sensorimotor experience in which the body has to compose constantly with architecture. Another experience that we can observe in drawings is the difficult to distinguish where the architectural operation ends and where the land begins. Graphics have features that also belong to the experience, and architecture

Fig. 2 Overlays successive sections of the three cases, highlighting in the first one the trenches, in the second one the camera obscure and the third one the total overlay

here is more identified with a weaving operation than with the separation of volumes and spaces.

4 Drawing as an Assembly. Trace and Gesture

In this research we should examine the capacity of the drawing to work as an assembly process in order to show non-apparent relationships. We will consider the next two graphs in parallel. The first one is a transcript made by ethnologist and archaeologist Leroi-Gourhan from a prehistoric site (Fig. 3).

The set up composed a scene that takes us back to the actions that have occurred. We may associate a valuable idea Leroi-Gourhan to this drawing, which can be traced especially in his work Gesture and Speech, and can be summarized as follows: every form is the trace of a movement, that form is nothing isolated from the gesture which engenders it (Leroi-Gourhan 1965).

In the second image (Fig. 4) we can observe the potential that resides in the action of drawing on Goethe's hands, an "amateur scientist" as he liked to define himself, devoted to gather as accurately as possible the phenomena and the fascinating diversity of the world. On the *Study of buds, flowers and branches* "the notion of morphology can be felt acting on drawings where, for instance, a flower will not be observed as that beautiful thing I put in a vase for a still life, but as a fascinating organism that must be understood both by precedent (the bud) and consequent (branch)." (Didi-Huberman 2010, 96). We are facing a mode of drawing where time occupies the space; different moments from the process coexist in the same table affecting each other. The transformation of organisms is not shown as a linear process but different rhythms and steps unfolded. This is, in fact, the attempt of knowledge about the assembly worked by Walter Benjamin, Aby Warburg and Carl Einstein, since "the assembly is the art of producing a form which thinks itself. It proceed philosophically as a dialectic … it is the art of reflecting the dialectical image" (Didi-Huberman 2004, 205). We shall rethink what is the power of the assembly: (Fig. 3).

Fig. 3 Archaeological drawing showing the location of huts built next to the cave à Renne Arcy-sur-Cure. Cantelperronien, about 35,000 years, Leroy-Gourhan (1965)

The assembly process is to shape a heterogeneous collection in which archives are built and contrast with each other rhythmically, making images and readability enhanced as a result of their relationship and mutual shock, "then the dialectic should be understood in the sense of a de-multiplied collision of words and images: images collide to produce the emergence of words, they collide so that thinking take place visually" (205).

Just as Goethe's drawing refuses to fix, to freeze drawings from our case studies had the same concern, they seek transcribing a particular stage in the *form-place* and at the same time they seek to gather the transformation potency of the artifacts. We can notice a tension between working in a process image without renouncing to define each of the figures and their mythical topos. This is something similar to what the "flamencos" call "building the picture" ("construir la estampa"[2]) as the

[2]The complete reference is: "Giorgio Agamben talked about how important it was for him the image in flamenco, flamenco has the capacity to build an image to immediately move it; the ability

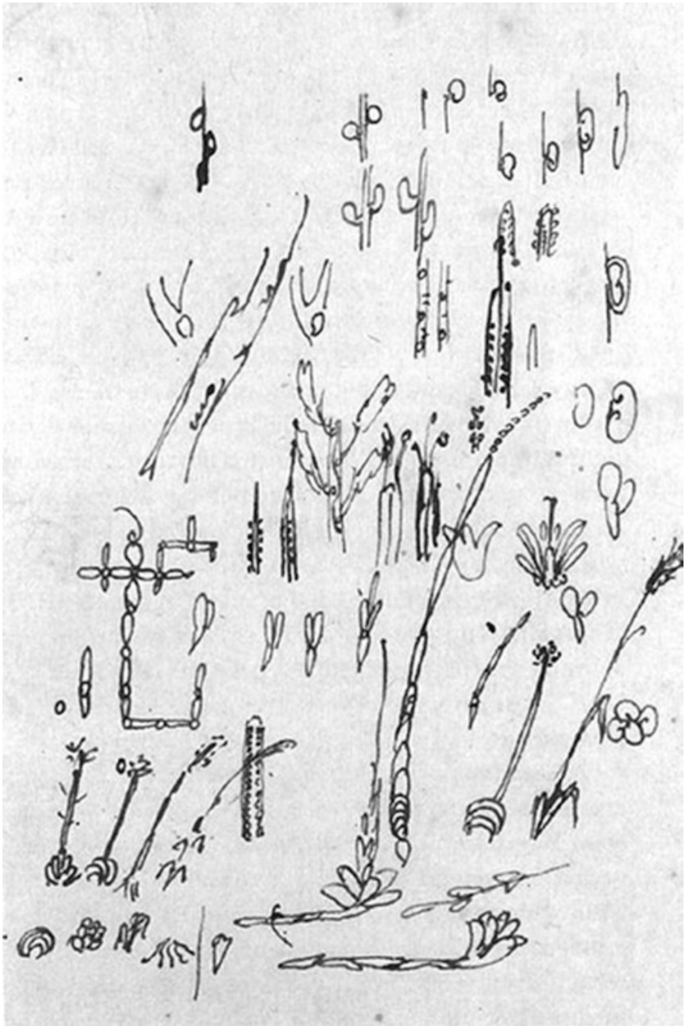

Fig. 4 *Study of buds, flowers and branches*, Goethe, 1787. Ink on paper, 15 × 11.7 cm. Stiftung Weimarer Klassik, -und Goethe Schiller Archiv, Weimar

(Footnote 2 continued)

to destroy and remake itself. He said this talking about the dance—it is what the “flamencos” call “build an image” but also referred to the music, the use of silence as moments in which the sound stops—like the use given by Luigi Nono—, where an intensity is produces and it transform the voice in a pure sound which is also an image, a big density significance image.” (Didi-Huberman 2007)

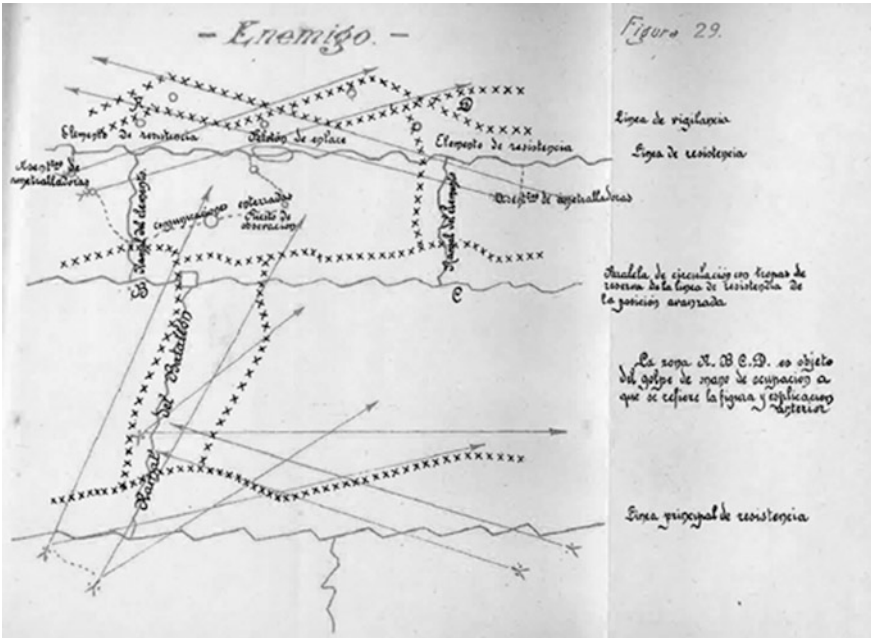

Fig. 5 Lines from a defensive war front, 1928

ability in the flamenco to fix an image to immediately later displace it and let it run again (Fig. 5).

About the tension between still pictures and range of motion we will approach one last question: which relationships can be established between the drawing and the territory? We will observe another two images. The first one is a military strategy chart that shows a war defensive system (Fig. 5). It is about planning a sequence of field operations, movements and positions. We could compare it to images from the petroglyphs traced on stone (Fig. 6a, b). In this case the drawing is done in the field, and it is not prior or after the spatial action, it is an action that is charging the environment with intensities, drawing here is a re-territorialization process. It is a drawing that reminds us that croon from whom is immersed in a medium, the *ritornelo* that is crossing the region and sewing it to body movements (Deleuze and Guattari 2006). Such in situ drawings show us the potency from drawing as if we were moving/dancing on the ground. The body who dances, or croons, is the same body which builds with equal intensity. Drawing here is not only an instrument. More than a *place-form* it is more about a *taking-place* of the form. And this taking-place, as we saw in Leroi-Gourhan, cannot be separated from the gesture that engenders it.

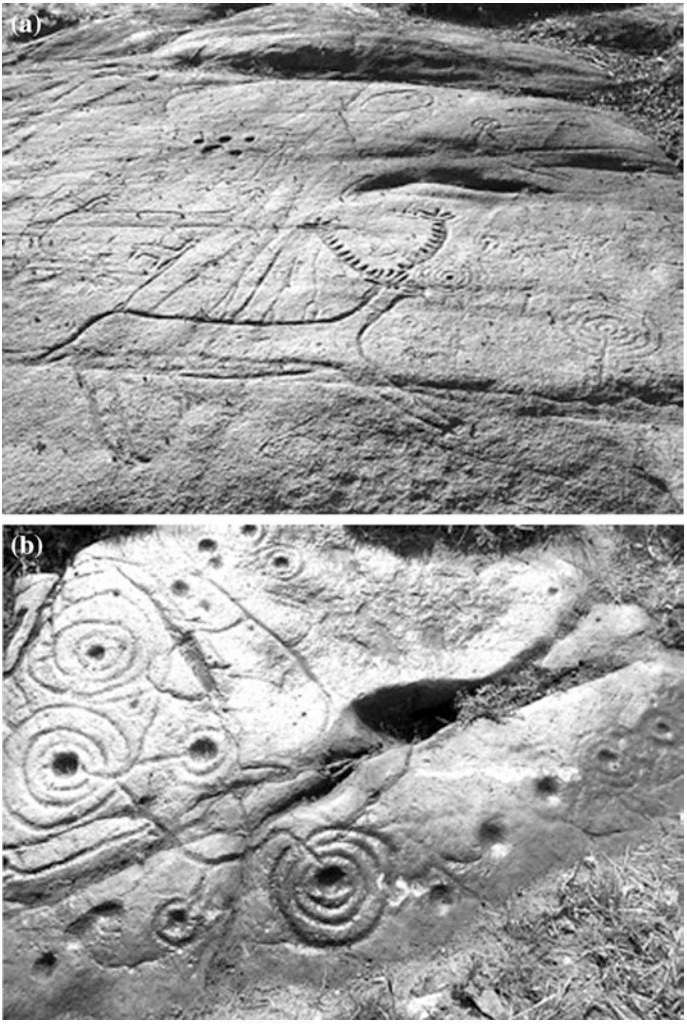

Fig. 6 **a**, **b** Petroglyphes en Old Bewick, Northumberland, Berwick Naturalist Club 1864 (Matthews 1922, p. 28)

5 Drawing Potencies. The Interwoven

Among the goals of this research there is one that tries to think the implications between drawing and building in the sense that they are two actions that cross the body. Another goal is to think images and architecture graphics after that everything had become an image and after we have defined a whole resistance philosophy against the eye and against the spectacle that our world has become. However we could try to consider that eyes (as sensory organs) are not the problem but the retinal gaze that has led us at this point. On architectural criticism it is Juhani Pallasmaa, after Merleau-Ponty sensibility, who has proposed a peripheral and unfocused gaze. Following this line of thought, philosopher Marina Garcés has proposed also a peripheral gaze in order to think on "us" in what she called "a common world." In her opinion our essential condition of spectators from both macro and micro scales –the world and ourselves–, is the result of the same system of vision, a naked and focused gaze "a gaze that escapes the body movement and its perception potencies and cancel, in this way, our relationship with the "in-between", that is, with the world as something that exists in-between, something that is woven" (Garcés 2010). The philosopher proposes us to relax the pupil and release the gaze leaving "the eyes fall back into the body", thus recovering that part of the tact and movement belong to them. Notice how we have tried before in the text to understand the implications between the drawing and building (two actions that pass through the body).

What has to happen so that body and language discover their necessary alliance with sensitive eyes, so mistreated by the western visual empire? What has to happen so that criticism of the centrality of vision does not push new contemporary Democritus to pull out their eyes, not just to see better with the soul, but to feel better with the skin or to sharpen the listening of the whisper from our cultural tradition? How to let our eyes falling on the body and assuming all political, epistemological, vital and artistic implications of this fall? (2010).

From this point we recognize on the action of drawing a way to attract the eyes to the body collecting in the fl what they see and fi in that gaze a more corporal sensitivity. It is not about renouncing to the vision, as Garcés warns "we do not tear us away the eyes to see better, but on the contrary: we need to conquer our eyes so that the Medusa that our world has became stop petrifying is. Conquering our eyes to enable us to something so easy, instead of perceiving the world in front of us they should learn to see the world in-between us" (2010). Is this "in-between" intriguing and tempting, like a lost space in a world without distances or worthless distances. At the end of this dissertation there is a last question: isn't the world that is "in between" us already the propitious place for architecture?

That space "in between" is which in nature enables the equilibrium again and again, it is the meeting place of exchange, where managing friction and differences. Some architects like Stanford Anderson have tried to describe the space occupied by the architectural work—the In-between—to name the relationship between architecture and its context and he has proposed the concept quasi-autonomy referred to the status architecture would have (Anderson 2002). Moreover, the case studies has offered us modes to infiltrate in the space "in-between", to create a interwoven that approaches the limits, searching equilibrium again and again, attentive to the phenomena and always ready to self-constructed. This "in-between"—interwoven—achieve an equal relationship with what happens at its edges, and, seen to take over a beautiful challenge proposed by Garcés wondering about "in-between", and "us", "what is at stake is the possibility to live releasing the world's wealth."

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Light Control in Mediterranean Architecture. Interdisciplinary Design Experiences Between Didactics and Investigation

Pierpaolo D'Agostino and Mariateresa Giammetti

Abstract The attempt of this work is to provide a cultural framework able to re-define a methodological accuracy that is part of the teaching of design and architectural composition, in order to develop performances even before formal works for architecture and construction. A particular attention is given to control lighting and shading in the design process in those places characterized by Mediterranean features. Our goal is to highlight the importance to manipulate the light in the architectural design also through a didactical project, aiming to the functional yield and the performance of building structures, as one of the cultural needs that point the technicians and designers much to the qualification of works of architecture as to the ex novo design.

Keywords Shadows · Architectural simulation · Infographic visualization

1 The Architectural Visualization in the Digital Domain. Specifics About Method[1]

In education to the architectural and engineering design, it is not uncommon nowadays to find remarks about the cultural obsolescence of descriptive geometry whenever it is thought incorrectly that several software applications available are able to substitute an human being for almost all actions related to the representation of the project. It's like to forget that in this way the domain of representation

[1]Pierpaolo D'Agostino managed independently the first paragraph.

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concerns, among other things, the training to the capability to concept the three-dimensional space and the cognitive domain of basic geometrical regulation of that applications that drive the design process. Obviously, if the purpose of the representation is concerned as a technical referential encoded language, about the creation of a graphic model is therefore conceivable looking at the domain of those descriptive rules that defines an unbiased way of understanding the represented space. It therefore drives to establish a methodological approach aimed at creating a strong framework within which to identify functional skills to the project.

In the challenge toward an update in teaching of the Science of Representation, it seems crucial to define how far it should be appropriate to provide capabilities and practical skills and when it is better to try to build knowledge and professional skills. In a personal point of view, in the first case, perhaps responding to current market laws, we lead to limit the contribution into a design project to mere operational sequences coming toward "an" outcome. In the other case, to acquire skills guarantees the ability to manage a process, dominating not only the operational phases but also how those phases should be forced to get "the" outcome.

About representation, as just mentioned is true both in the creation of a graphic model and in its reading and interpretation. This affects when the dialogue is among technicians equally trained, while kinds of exemption may be assigned when is clearly expressed the goal of disseminating information in a dialogue with non-expert users. For such cases, there is no doubt that today the render has an hegemonic role in its ability to visual narrator for the assessment of visual impacts. The render reaches the viewer better than text, calculations or 2D visualizations.

Therefore, it allows a crowd pitch in the evaluation of the expected results, regardless, moreover, the effectiveness in realization. That justifies the high presence and popularity in particular applied to the final restitution of the idea, at a stage that is where the intensity dominates the formal precision (Oxotorena 2012). In this sense, it highlights the inherent deceptive power: the simulation is able to divert then from the technical documentation, as filter and manipulation of the information, leading to a choice. And who has decision-making, economic and political power in the implementation of a project, it is often alien to the world of technology and is to be in convinced the choice (Fig. 1).

This outlook applies also and especially when the user is due to the generation of digital natives, fully immersed in the digitization of daily life and led to think digital applications as unique and vital encouragement for the understanding of reality and, therefore, to reach the most effective form of communication and expression.

The recourse to render it so widespread that it is appropriate to define the render training graphics branch of knowledge, educating to a tool useful to figurative design.

Traditionally—and according to a design practice still in vogue in Italy—the steps to figuration and representation are distinguished not only about the executive ways, but also technologically. The current trend, that however requires a cultural

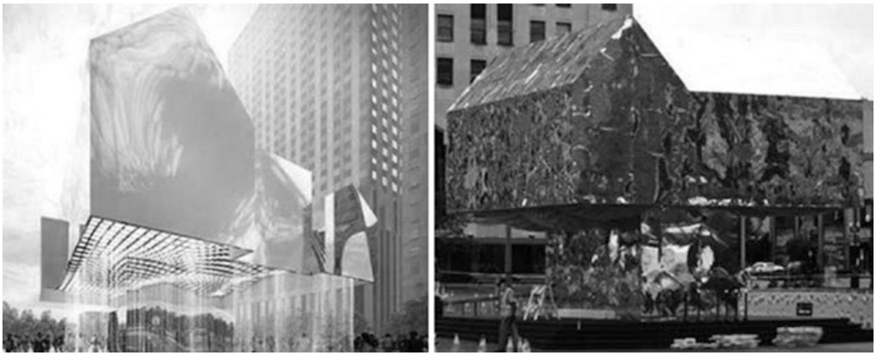

Fig. 1 At *left*, proposed renderings of Mark's House and at *right*, the project as built, cfr. The Flint Journal

disruption even before a proper training, is oriented to eliminate as far as possible the orderly sequence to provide the technical tools for managing structured and interoperable information: platforms that can integrate applications targeting digital models properly configured to provide verifiable, editable and manageable data implemented through user-friendly graphical interface. Models, then, are themselves appropriate to define visualizations made to show project results.

If such management design approach is inherent in the called BIM (Building Information Modeling) platforms, where the generated model can be loaded with information not merely limited to the formal point of view involved to clarify and verify the different one—structural and functional features, materials, thermo-physical evaluations, lighting etc.—with appropriate tools related to the mere geometric model, the same cannot be said about the management of the defined digital graphic model.

Referring to these platforms that the digital market offers, a question may arise: if the project evolves and is in a process in so defined software environments, to what extent it becomes the crucial the intervention of the designer? Are software tools really "independent"—and to what extent—of him? In the case of positive response, then there is the risk that the designer goes cultural becoming an operator instead of being a *demiurgo*.

Digital design must therefore be the means, not the goal however. However, this is still the need to better manage digital domain in a conscious way and on training in representation educating to the rules—among them, the geometrical ones—that lead to a wise use of those tools characterized by high nature and level of technological innovation reached.

As confirmation of the previous thoughts, the renewed leap towards a called sustainable design, settled on a low impact on natural ecosystems through actualized design practices with new tools and technologies addressing issues such as the thermal adjustment and the regulation of the visual comfort of buildings, particular attention can be given to techniques of shading. These can be as a means of active or passive control of solar radiation, solar shading systems in this context becomes a natural example of the role played by descriptive geometry in the creative and design development, in order to achieve a balanced outcome between actual techniques and architectural composition, in which solutions are organically framed —and used—for a formal characterization step of compositional uniformity (Figs. 2 and 3).

Considering the solar movement as relative movement of the Sun than the Earth, considered as a referenced sunpaths in the sky, it is therefore necessary to identify what are the ways in which the sun's rays have to impact Earth's surface and objects placed on it. That is like to consider sunlight in their vectorial feature, cut off from their energy content. According to these conditions, then, you can take advantage of the rules established in the framework of projective geometry and the theory of the shadows associated with it. But there is a side of the scientific community who, recognizing the right deserves about the contribution of new technologies applied to the design and, more specifically, for the presentation and the visualization of the design, offers more and more vehemently a drastic re-arrangement of the theoretical knowledge required in training of future

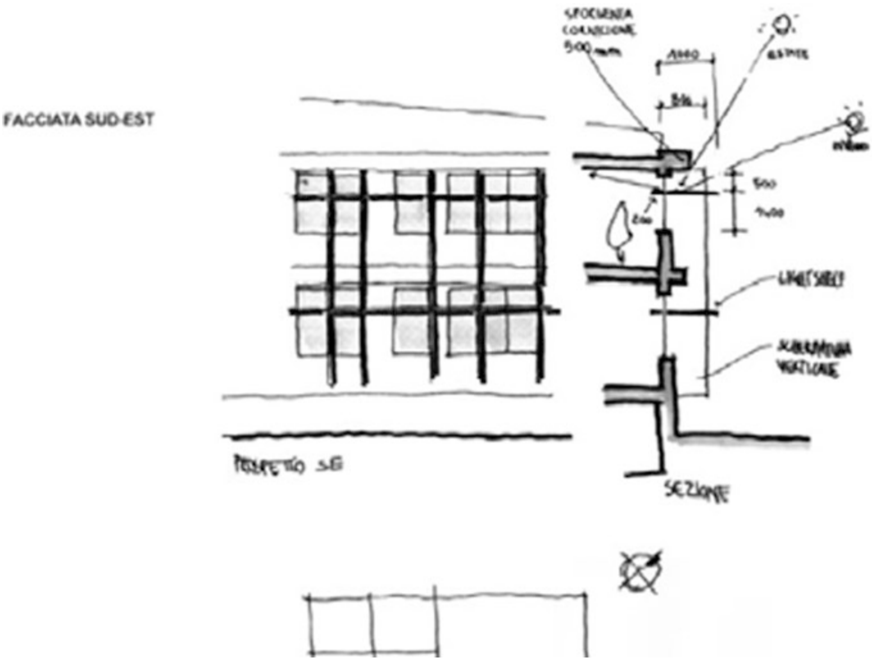

Fig. 2 Arup Italia, recovering a school in Rimini: preliminary sketches and lighting assessments (Imperadori 2008)

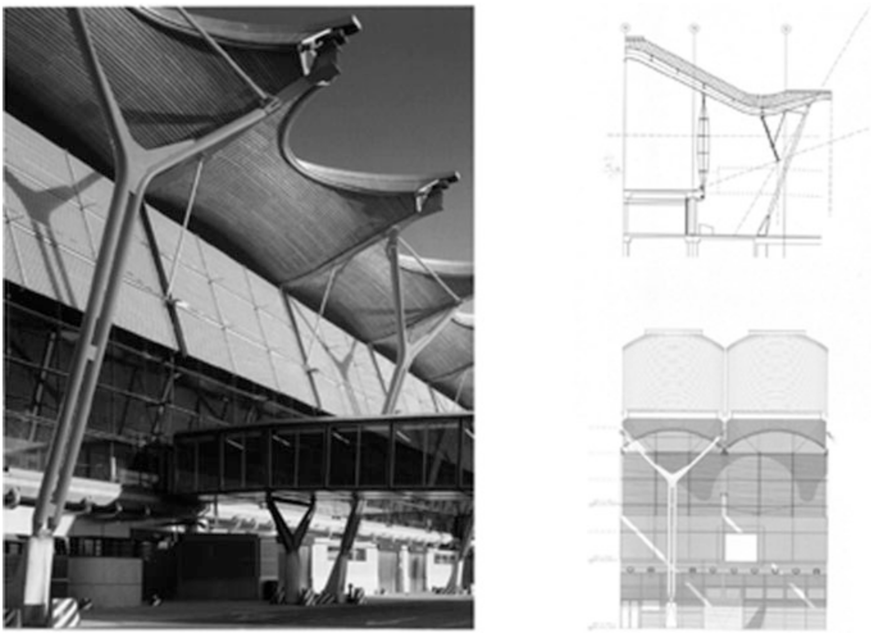

Fig. 3 Barajas airport in Madrid. Architectural solutions and their technical drawings

technicians. Indeed, the use of shadows applied to the digital model can be differently calibrated depending on the objects to which the modeling is referring to. About this, when the study is finalized to the project design presentation, the tendency is to provide a photorealistic render. However, when the model is aimed at a stage of study of sunlighting and shading about expected outcomes, it is habitual to resort to a more sparse, less realistic visualization but better to define how the volumes under the light are going to comply themselves. An approach able to achieve a sensitive and enlightened functionalism, then, that remains separated from issues involved in fascination and mere perception. It is true, on the other hand, that a similar approach, without texturing, aimed to define spaces, can also be effectively used as a model of presentation, following a form of expression typical of what it could be called "morpho-typological rationalism" (Vanini 2010) where what is intended to emphasize and then highlight is the relationship between the parties and not a simulation of the future solution (Fig. 4).

To answer to the implicit question of what is the relationship between software application and shadow theory, it should be noted that where it is difficult to define what the shading caused by formally complex conformations, digital models and render help and participate to integrate, not to replace, the synthetic theory explaining how the light rays impact and transfer on volumes, by means of specific graphical methods. However, this aid tends to shift the focus on the effectiveness of the result rather than on the process to achieve the outcome. Or rather, the single

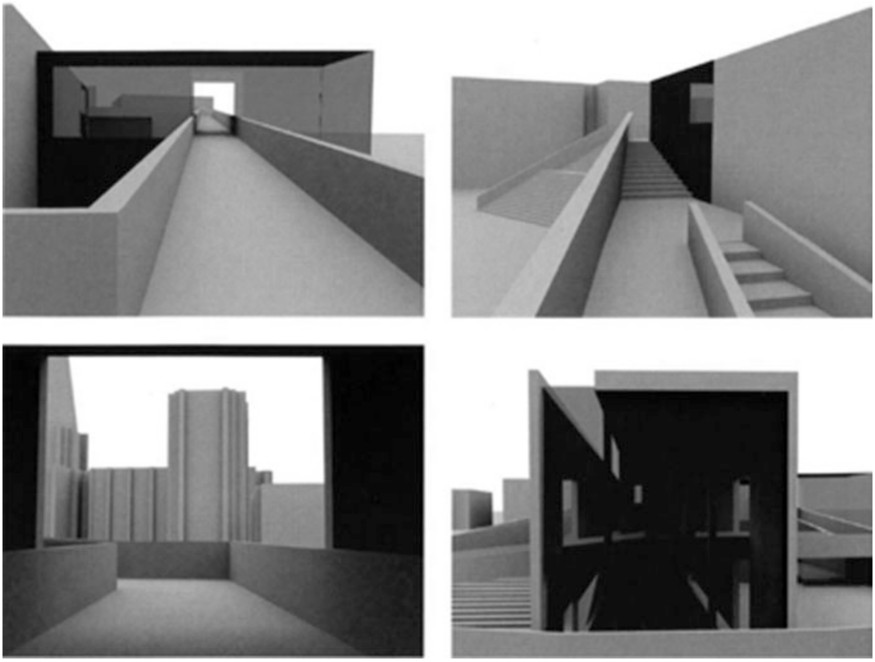

Fig. 4 How simple renders could help the real-time simulation process

cares required do not relate particularly to how to read the shadows as a result of a path of ray lights, but the most appropriate and better dominated computer process. To ensure that this digital system then becomes useful, is necessary to define the process within the projective system formally correct in which to frame the model, whose rules are, in their analytical declination, in accordance with the concise definition traditionally understood, regardless then the graphical method adopted. Indeed, in this last issue, perhaps is the use of digital modeling and rendering—in the current level achieved in real-time simulation—since the earlier planning stages that lets true great advantages in the disposition given by the adopted system, in the dynamic transition from graphical models to move from a specific graphical method to another. Then, it's better to use an isometric view for easy interaction with the model, it is quite expeditious move to photorealistic visualizations of points of view perceptively consistent, aimed to the control of possible visual impacts, through the management of the quality and controllable geometrical features via orthogonal views. It goes without saying, of course, that at every stage and display the correctness of the expected outcomes is directly proportional to the prior knowledge of the projective system, where this should be, however, the tool to the strict definition of that representation, even when there has been a digital display device, is a two-dimensional supported visualization.

2 The Role of Light in the "Mediterraneité"[2]

As drawing is a means for the space representation, the light may be the means for the construction of every architectural space. For the so-called Mediterranean architecture the contrasting light and shadow, becomes "physical light", space matter, that has so much expressive power as to create an empathic feeling in the watcher.

The drawing of light and the light control are very important in the design of architectural space to create this expressive power of architecture, which turns into emotional force, transmitted to the watcher.

The light design can be a means to bring in the project of the space our cultural back ground, to bring a idea of space that come from the our figurative memory.

Le Corbusier defines architecture the masterly, strict and magnificent play of the volumes under the light. The Le Corbusier definition is all focused on the relationship between light and form. That definition takes on greater significance when compared to his relationship with the mediterraneité, from which it draws some of the driving themes of his architecture.

"Over the years I became a citizen of the world. I traveled across the continents. But I have a deep bond: the Mediterranean. I feel deeply Mediterranean. Mediterranean realm of form and light. The light and space […] My contacts, my sources, you have to find them in the sea, I have never ceased to love […]. The sea is moving, endless horizon".

The Mediterranean is the realm of form and light. The light of Le Corbusier is like a glaring sun, which floods the space with a light filled, which enhances the color in all its power and she can give life to an strong, essential, rigorous and harmonious architecture.

Le Corbusier trace the profile of rationalism and of Mediterraneité, building this idea around the light and its relationship with the form. The light that describes has the Mediterranean colors, and retains the dual character Apollonian and Dionysian of the ancient greek spirit: mathematical rigor and law of numbers that are the basis of harmony; expressive force or physical light that is immediately transformed into powerful emotional pathos that, together or in opposition to the logos, is one of two forces that rule the human soul.

The light was the first material of creation and she is the central element of the building and the creation of space. Chaos reigns without the light, which in ancient greek means ravine, then symbolically means abyss, where are darkness and gloom. Chaos is the opposite idea to Kosmos, order, harmony, that underlies the idea of the cosmos as an expression of the order, the divine proportion and harmony itself.

At this cosmological aspect of the Mediterranean light is added to its expressive component: the light coming on surfaces consumes the matter giving rise to the shape and character. Light is matter and material, reveals the shape and leaves perceive the geometry in relation to space and emphasizes its character through the role of empathetic contrast light shadow. What better example to understand the

[2]Mariateresa Giammetti managed independently the second paragraph.

expressive power of the shadow and the role of light in the unveiling of the form, of the group of six statues by Michelangelo Buonarroti made for the tomb of Julius II, known as the Prisons. Although these are sculptures and not architecture, the Prisons are an example of the expressive power of the light or better than his negative, the shadow, in relation to the genesis of form. The shadow that darkens the fold of the abdomen of one of the Prisons, shows the character of the sketched outline of a man, who bends all right around that shadow, under the weight of the mass of shapeless marble that rests on the shoulders. The prisons are an expression of what is "between" the original block of marble and the shape that emerges: a man silhouette that begins to take the light from the matter and which it appears when the light and its negative, the shadow, outline plastically shape of those bodies. In these sculptures the genesis of the figure is a "give to light", the matter modeled through the tool of the geometry and of the harmony of proportions. That man that gradually comes out from the material, is formed only in the moment in which it comes in contact with the light, the light reveals the geometric characteristics of that body and allows the perception and knowledge. The opaque masses of the same body, exposed to light, generate the dark shadow, more or less intense, that immediately turns into emotional power, transmitted from a body that imprisoned by the material, looking forcefully, through a convulsive motion, to get out.

As well as the prisoners show their presence in the world when the light collides with their material, whether Le Corbusier, in the study for the project of the church of Saint Pierre in Firminy, adopts a technique of excavation and sculpture of the matter to model the space. Le Corbusier subtract material to obtain a space all round, in which the shadows of the great void is animated by the beams of light projected from the holes that form the constellation of Orion on the surface above the altar.

In this space the twilight is the light turned into beams to build the given emotional. Le Corbusier performs a complex job that develops in controlling not only the intensity and color of light, but even in the control of the shape itself of the light beams. The study of light is the design of the internal space.

Moving from the bottom upwards, Le Corbusier uses mechanisms different lighting: top big eye sends rain zenith light, which thanks to the color of the section of the hole, it assumes a yellow color, so that the one that comes from above is a warm glow with strong emotional components. The yellow light reflects on the sloping walls, spreading from the top of the classroom. In contrast in the lower part, the windows reflect a cold light, thanks to the green and to the blue of the jetties which cover the openings. On these cuts Le Corbusier studying a mechanism that brings cold light illumination, reflection, emphasized even more by shades of blue and green.

When the light reflects on the surfaces enter the classroom with a chromatic, that is the one of the primary colors. The bright open slots at the bottom of the shell make it look outstanding with respect to the floor. What happens between the top

Fig. 5 On the *left*, I prigioni: schiavo che si ridesta (Michelangelo Buonarroti, Galleria dell'Accademia, Firenze). On the *right*, Saint Pierre at Firminy, Le Corbusier. A view of the church hall

and the base of the shell? The space is transformed into a machine for the light where the beams of light that pass through the lenses which close the open holes in the wall on the altar, seem to wrap it in a spiral of light that captures the gaze and projects it upwards.

The beams are constantly changing to the changing position of the sun and with them changes the perception that one has of the classroom, introducing space changing of this architecture the fourth dimension, time. On smooth surfaces of concrete Firminy light beams produce a liquid light, that seems to be slipping on the walls, making a very different effect on what you can feel in contact with the wall pierced with openings splayed Chapel of Notre Dame du Ronchamp Haute. The light is captured by the plaster, forming lumps of shadow. Heavy matter imprisons the light in the same section of the wall, where the constellation splayed windows emphasizes the theme of depth thanks to the light passing through and going from full color, to the gloom, until the grain in the shade of the interior space. Material and light come together in a quilt of dazzling light and dark granosi who have the task of encouraging the spirit (Fig. 5).

3 The Use of the Section in the Study of Light. The Didactical Experimentation[3]

In order to treat the issue of light in the design process, an experimental teaching has been developed as part of the second year curriculum of the course in Civil Engineering for the classes of *Composizione architettonica* and according to the matter of *Disegno*. The challenge was scheduled to provide all the tools, both in the traditional and infographics domain, as the basis for useful rendering to project management. In this sense, the support of the descriptive geometry get involved in completing the methodological approach aimed to the realization of a design theme. The essential idea was to instill in students that critical sensibility aimed to the optimization of an architectural design process, regardless of the available tools. So, not using advanced software platforms specifically focused on sun shading, generally considered as evaluation instruments useful in the last phases of the design process, we aim to drive students in a wise use of simple computer graphics steps—only AutoCAD® and its Mental Ray® render were used—in order to reach the same outcome implementing them, furthermore, in the main design process and not only in an evaluation phase.

The theme of the year is the project of row houses in Salento, Puglia, in an olive grove near one of the many small towns of this charming area of the south of the Italian peninsula. The architecture of this area is characterized by belonging to the so-called Mediterranean that so fascinated Le Corbusier and many other architects of modern rationalism. Here the Mediterranean is poverty and in architecture, that poverty leads to essential forms that derive directly from everything that is "needed": need to use and make the space as is transmitted by the culture of those places. The project area is an olive grove more or less trapezoidal, where the olive trees form a knitted checkerboard marked by a steady pace that gives rhythm to the space of the entire area. From one end of the area there is a difference in height of about five meters, marked so as to have a difference in height of one meter every hundred and fifty meters.

The theme involves the design of twenty terraced houses to be arranged orthogonally to the contour lines, whereas the grid of the olive trees in order to move at least trees is possible and in order to conceive the intervention not as a system that is superimposed to the natural place, but as a design strategy that can draw inspiration and to enhance it, not houses on the nature, but with the nature. The particular type terraced makes each residence can only take light from the two short sides. Considering that every house have to cover a floor area of 200 m^2 and have two floors, for this reason every batch stretches a lot, developing the ability to be able to take even light from one or more patios to open within each home, thus developing a domestic space all around introverted small domestic courts. The idea of working on long parcel and on patios, as well as being born from the need to

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[3]The last paragraph was edited by the two authors together.

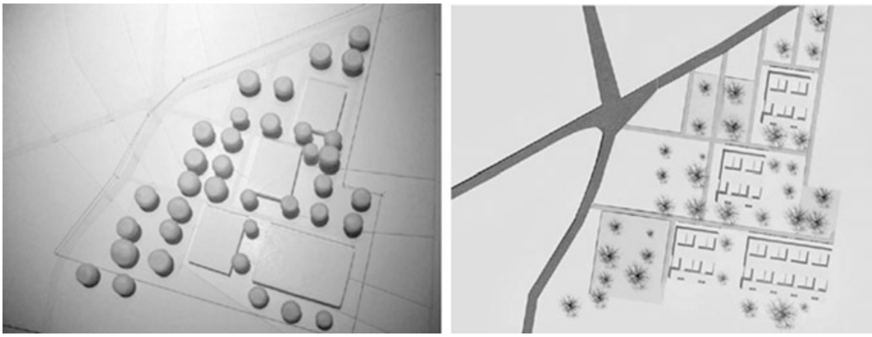

Fig. 6 The site. Traditional model versus digital one

bring light and air into, given the paucity of surfaces on which you can open windows, was also born in order to develop a typical concept of the Mediterraneité theme: the depth, the heat and the shade in the Mediterranean house hence its light (Fig. 6).

The first step of the teaching investigation has been developed as seminar activity in which it had been expressed the role of leading the descriptive geometry. In this sense, to give continuity and completion about basic representation teaching, it was intended to provide the entirety of the class the traditional methods about the application of the theory of shadows, linking thus knowledge already acquired about the graphical methods completing the theoretical framework, filling in this sense a essential cultural gap in the basic courses specifically intended for the representation.

This approach resulted in the teachers involved to be guaranteed the full students' capability about the use of traditional representation techniques involved in design from the early stages of the process, even before still guaranteed capability in model management aimed at the graphical representation—especially in orthogonal and isometric perspective domain—of the adopted solutions. Given the peculiarity of the theme, the section has become one of the most appropriate tools to address it. Whit the section has been studying the problem of the difference in height, working at right angles to the contour lines. In this project it has resulted in the necessity of having to deal with a difference in height of about one meter between the two extremes of the parcel. For this, often fools have become valuable tools because at these points could have broken the continuity of the floors and absorbed the difference of shares. But the session was an essential tool especially for the study of light: in fact, the theme of the depth can be well appreciated through this device graphical representation. If the depth is Mediterranean, it is at the same time also shadow, or lack of light and the lack of light is not controlled can turn into a dysfunction of the domestic space. If the depth generates gloom and coolness, that is functional to the microclimate of the house. But if the depth is shadow, where no use, then this indicates a fault in the design of the domestic space. The section, through the study of the shadows and the positioning of the bodies opaque than

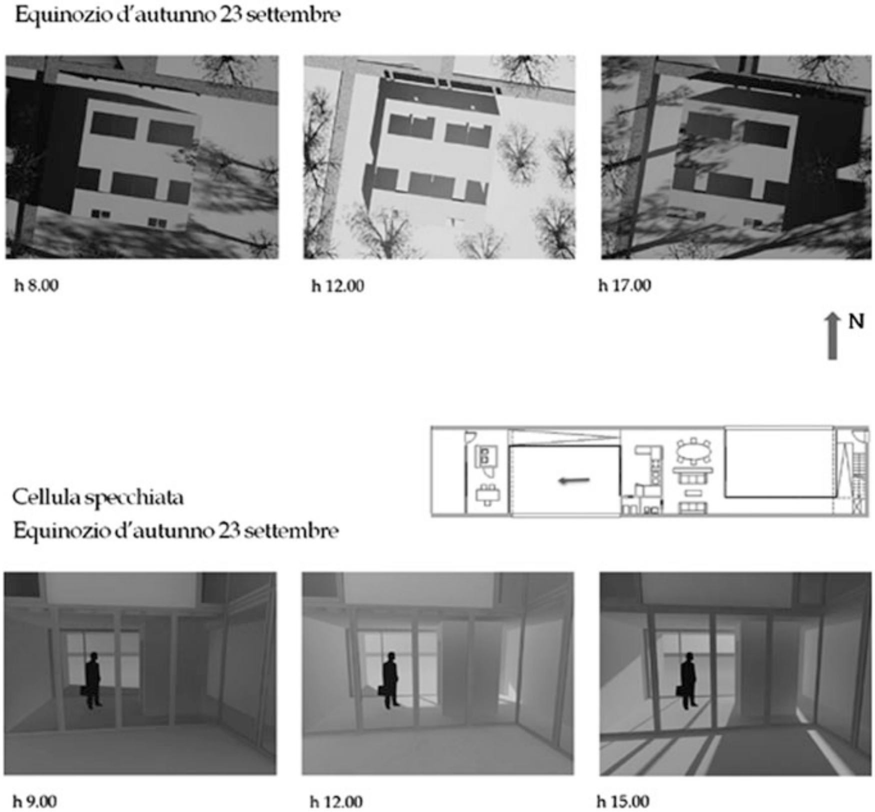

Fig. 7 Renders oriented to the comprehension of the optimized solution

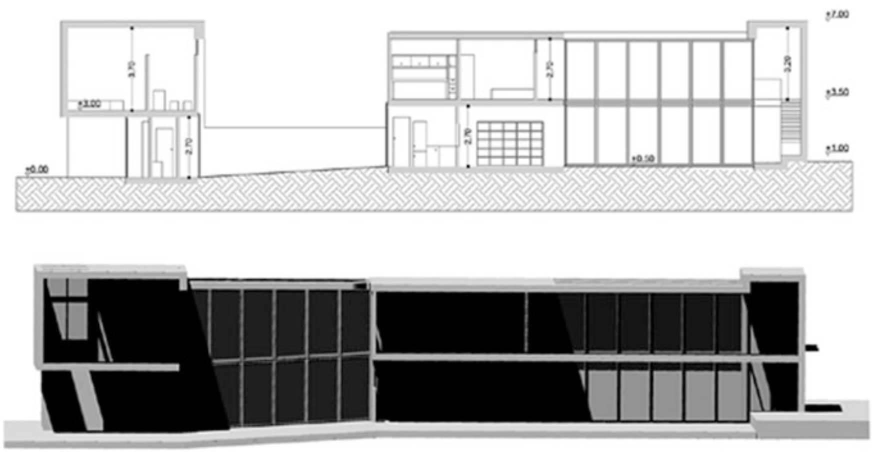

Fig. 8 The section from traditional graphics to real-time rendered ones: sunlighting concurrent evaluation for project optimization

light sources is the instrument through which to control this little light machine and compensate the relation- ship between light and shadow air (Figs. 7 and 8).

For an optimization of the predictable outcomes in the experimentation, then, it was made a selection of students deemed most deserving after an evaluation of the best results of preliminary exercises, highlighting their best assimilation of essential cultural background to the further design phases. In this selection, we were involved in the creation of a second set of training seminars about digital graphics tools aimed to the management of the project, particularly those intended for the advanced modeling and rendering. In addition, the students were driven to an evaluation of the appropriate arrangements for bending the theoretical tools acquired during the seminars at the collegial in the editing of their digital project: where to stretch, how to manipulate surfaces in order to reach the better sunlighting or useful shading. They were involved in the application, in further operational checks, to the results traditionally obtained exploiting with new technologies learned, so among other things to critically evaluate the strengths and weaknesses of the two approaches.

In our opinion, the goal of this experimentation is the quality reached by the selected students about their projects among other ones, where is clear how the control of sun rays in a geometrical approach, together with the real-time modification and evaluation of shading offered by computer graphics tools, drove toward a wiser comprehension about the best design conditions to get.

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Part IV
History and Cultural Heritage

The Layout of a Gothic Dome Base. Geometry and Construction of the Octagon in the Guarç's Gothic Layout (c. 1345–1380)

Josep Lluis i Ginovart, Agustí Costa Jover, Sergio Coll Pla and Albert Samper Sosa

Abstract The study of the Gothic layout of Guarç (c.1345–1380) through its imprints allows the determination of the methodology of its outline. The outline of the octagon dome is determined by the geometric method of design. At the same time, the proportional theory that exists behind the parchment allows the transport of the project to the site using simple metrological arithmetic operations.

Keywords Gothic · Medieval geometry · Octagon

1 Introduction

In the Capitular Archive of Tortosa's cathedral (ACTo), a Gothic layout was released by Matamoros (1932). The parchment represents the projection of a plant with the notation "En Antony Guarç". Guarç's parchment is one of the small numbers of orthogonal representations of a cathedral project preserved from medieval Europe. The study of the Gothic layout of Guarç (c.1345–1380) through its imprints allows the determination of the methodology of its outline. The outline of the octagon dome is determined by the geometric method of design. At the same

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time, the proportional theory that exists behind the parchment allows the transport of the project to the site using simple metrological arithmetic operations.

There are not many representations of Gothic *ichonographia*. However, some of the representations from existing buildings are conceived as typological notes, such as Villard de Honnecourt (c.1175–1240), (BNP ms.fr.190093), Notre-Dame de Cambrai plans (fol.14v.), the Saint-Etienne de Meaux cathedral (fol.15r) and Vaucelles abbey (fol.17r) (Lassus 1858, 112–124, 130–131).

Other representations are considered examples of models, such as those attributed to Michel de Friboug, which are the París and San Croix de Orleans (1388) cathedrals and the Musée de l'Oeuvre Notre-Dame de Strasboug (Inv.29, Inv. 21) (Bucher 1968, 59, Fig. 15, Vandekerchove 1989, 317–318).

Other plans are considered a global project from a part or the totality of the buildings. Therefore, these plans have a mission to advance the future of the buildings, and they relate to Guarç's parchment. The global projects are as follows: the Steyr plan (Vienna Akademie ABK no 17052), Zagreb (ABK no 16926), Augsburg (ABK no 16846), Kuttemberg (ABK no 16841) (Bucher 1968: 59), the Nürnberg plan, (German-isches National-Museum) (Bucher 1972), the Milan cathedral project that is attributed to Henri Parler (c.1392), (Musée de l'Oeuvre Notre-Dame de Estrasburgo, Inv. no 29), the plan from Antonio de Vicenzo (1390–1392) (Museo de San Petronio de Bolognia, cart. 389, no 1), and the (S2–S3) Siena Duomo and Museo dell'Opera della Metropolitana plans (Carli 1979, 22–24; Ascani 1989; 268–270; Ascani 1997, 89–94).

Finally, partial Gothic masonry projects can be found. This is the case of A Project of Colonia (c.1280–1308) (ABK no 16873) and the E attributed to the Master Johanes (c.1310–1320), (Dombaurchiv des Metropolitankapitels Cologne). The project of the presbytery of the cathedral of Strasbourg, (Musée de l'Oeuvre Notre-Dame de Strasbourg, Inv. no 6 v.), the deformation (Inv. no 06/10/11) and façades (Inv. no 15/16) and the draft counter (c.1350) (Hauptstaatsarchiv of Stuttgart Inv No. N201) also include partial Gothic masonry projects. Other examples are the tower plans of Vienna's cathedral (Museen der Stad Wien, Inv. no 105067), (Vrijs 1989: 412), the stair plans of Vienna (ABK no 16.855) (Vrijs 1989: 372), the (ABK no 16953) (Bucher 1979: 72), and the examples from Strasbourg's stairs (ABK no 16.832) and (Victoria and Albert Museum no 3550) (Recht y otros 1989, 405).

In Spain, the late Gothic drawings with complete floor plans are dated after Guarç's plan. This is the case of the Seville cathedral, the Convent of Bidaurreta (1433?, 1490?) (Alonso y Jiménez 2012, 57–77; Alonso y Jiménez 2009a, 63–74) and the parchment by Bartolomé de Pelayos for the cathedral in Coria (1502) (Sánchez 1982, 63–76). In addition, there are the floor plan of the Church of San Bartomé in Javea (1513) (Zaragozà 2003, 175–176), the Church of Segovia (1524) by Juan Gil de Hontañón (Casaseca 1978, 2951), the plans of Juan de Alava in the convent of San Esteban in Salamanca (1524) and the Salamanca cathedral (c.1537) (Alonso y Jiménez 2009b, 116–117).

The aim of the investigation is to complement an initial work about the layout of Guarç (c.1345–1380) where it is assessed the layout of the heptagon (Lluis i Ginovart et al. 2013). Thus, present work completes the initial study with the layout

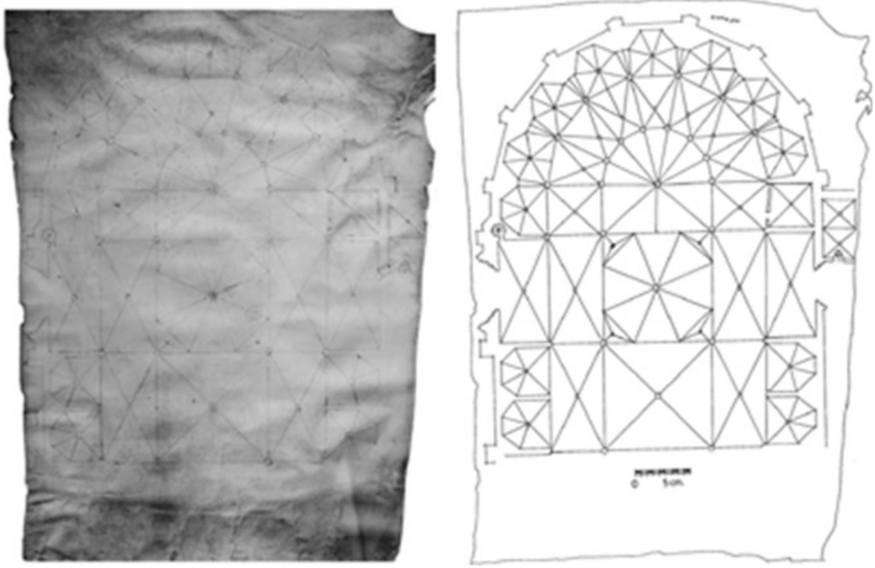

Fig. 1 Guarç's parchment. ACTo. Fábrica no 49 (c.1345–1380)

of the dome through the figure of the octagon. The methodology used for the study of the document is based on the analysis of its auxiliary layout and the lines and compass points on which the final plan is drawn. The studies ms. 1092 Stiftsbibliothek from Sant Gall (c.820) are a model to explore Guarç's layout (Horn y Born 1966, 285–308; Fernie 1978, 583–589; Horn y Born 1979; Nees 1986, 1–8; Sanderson 1985, 651–632). The analysis of the imprints allows to stablish an interpretative methodology of the graphical construction of the octagon (Fig. 1).

2 The Traça of Guarç

Guarç represents the plan of a design for the chancel and part of the body of the nave of a cathedral. The system for representing the entire building is an orthogonal projection, *ichonographia,* except for the detail of the door of the adjoining chapel, which is shown as a vertical projection. Matamoros believes that the plan of Guarç was part of the preparations for the Gothic building before Bernat Dalguaire and Benet Basques de Montblanc (1345). Almuni dates it to the resumption of the stonework in approximately (1375) with the onomastic appearance of Guarç in the work accounts from (1379–1382). Thus, the chronology of the layout must be from the periods (1345–1380) (Matamoros 1932, 52; Almuni 1991, 362–364).

The basilica floor plan with three naves, a dome, and a polygonal apse was never built. The chancel consists of eight interconnected hexagonal chapels with *heptapartite* vaults and a square floor plan with a simple vaulted ceiling, which is laid out as a double ambulatory. The ambulatory has a regular layout, with two rectangular sections and seven trapezoidal sections with a displaced keystone. The presbytery has a central keystone and eleven ribs. The body of the three naves contain two complete structural sections. The first section is roofed with a dome, an octagonal plan, and an *octopartite* vault with intermediate ribs; the second is a simple vaulted ceiling. The lateral naves are half the size of the central module and have a rectangular floor plan with an extended vaulted ceiling. The side module has two chapels with a hexagonal floor plan and is roofed by *sexpartite* vaults.

3 The Imprints by Guarç

An analysis of the preceding imprints to the final plans allows us to establish an interpretive methodology of the possible graphical construction. Several points on the support penetrate the parchment. There are marks that break the surface of the parchment: some points are located on the perimeter to fasten the parchment to its support, other points are from compass marks that could be used to transport measurements or for tracing circumferences, which penetrate and break the surface of the parchment. An analysis of the auxiliary lines and points gives us the drawing sequence and determines the number of graphical operations. Some points are used only once, others are used twice, and others (such as PO.1) are used up to five times, which comprise most of the base of the auxiliary drawing.

The lines modify the surface of the parchment, and are drawn using a punch (straight sections) or through a two-pointed compass (for circular layouts), while others are similar to graphite strokes. The technique that uses sharp tools frames the drawing and establishes the proportions, whereas the graphite strokes were placed as auxiliary strokes and then fixed with final ink strokes (Fig. 2).

The sequence of auxiliary lines should have been:

- T0. Fixing points on the edge of the parchment, the incisions pierce the surface.
- T1. Fitting lines of the drawing. The border lines T1.1 and T1.2. A point in T1.1 is used to lay out T.1.3; the measure between lines T1.1 and T1.3 is the module used for the lay out of the plan.
- T2. Fitting lines of the plan. T2.1 is located at the mouth of the apse. It is the starting point for determining the ratio of the width of the naves. A line outside the main drawing is drawn, T2.2, which is divided into six equal parts.
- T3. Vertical composition lines of the plan. T2.1 contains points with a dual function. Some are used for the lay out of the dome, and others to set the proportions of the central nave related to the lateral naves. The first point is located at 1/3 of the total length, and the second at 1/6. The sequence of the lines is drawn as follows: the total width of the plan with T3.1 and T3.2, the width of the central nave through T3.3 and T3.4, and finally the widths of the side naves, with T3.5 and T3.6.

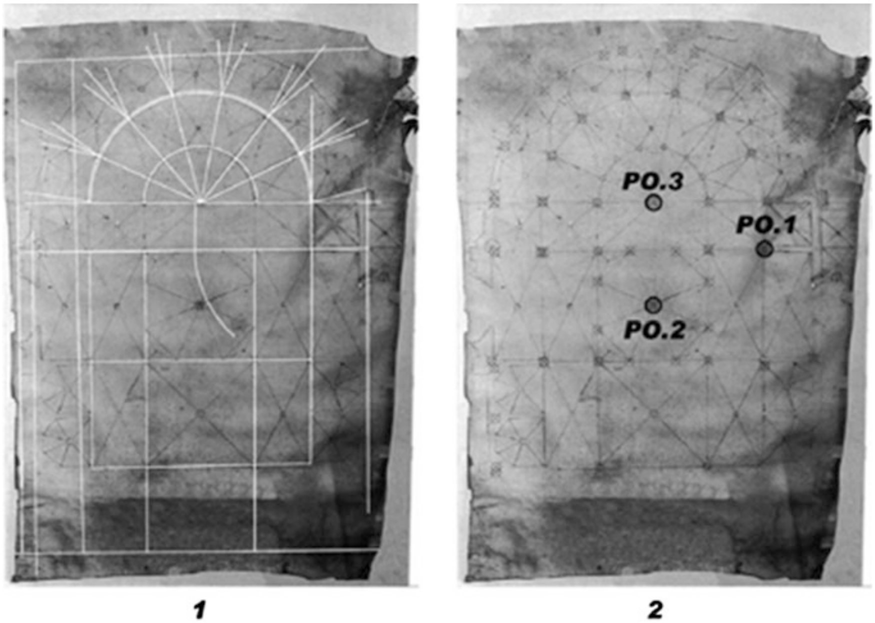

Fig. 2 Types of auxiliary imprints. *1* lines, *2* points

- T4. Horizontal composition lines of the plan. The horizontals lines T4.1 and T4.2 cross the vertical drawn before, shaping the structure of the nave. At this point it was possible to draw the dome or also the apse.
- T5. Composition lines of the apse. It is drawn an arch from T4.1 to T2.1and centre in PO.1, named T5.1. Following is drawn the vertical line T5.2, which end determines the location of the semi-circular apse. This process can be interpreted as the method for laying out the heptagon.
- T6. Layout lines of the apse. The line T5.2 has the same length as the distance between the points (T2.1–T3.3) and (T2.1–T5.1). It determines the location of the straight section of the presbytery, marked by the line T6-1. The point PO.3 is the centre of the presbytery and the arches T6.2, and its correction T6.3 according to lines (T3.5-T6.1). After, the arch T6.4 completes the presbytery.
- Lines T7 and T8 are the main lines in the auxiliary operations to determine the construction of the apse (Fig. 3).

About layout points PO, there are:

- PO.1, origin of a lot of both layout operations and measure translation.
- PO.2 centre of the dome.
- PO.3 Keystone of the choir and centre of apse layout.

The layout of the dome drawn on the parchment takes the main line, T2.1, at the foot of the presbytery as the base and constructs the structural square, which

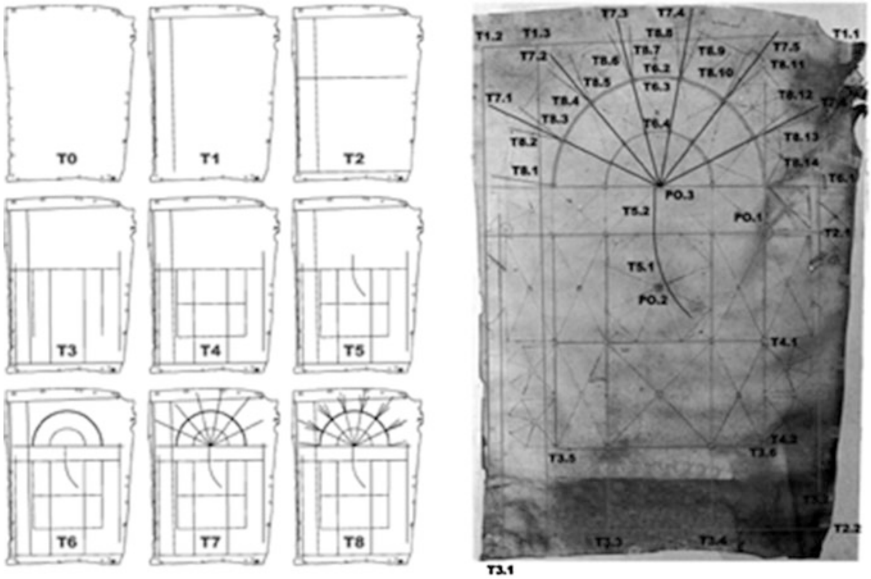

Fig. 3 Layout sequence, auxiliary points and lines

contains the dome. A compass point is observed at P1, P2, P3 and P4. The centre of the square, PO.2, was laid out. This point is determined by the intersection of the diagonals (P1–P3) and (P2–P4) where the auxiliary layouts of graphite are still visible. The opposite vertices of the square (P1, P3), have two compass marks unlike the rest. The points P5 and P6 are obtained by rotating the segment (P1–PO.2) on the side (P1–P2) and the side (P1–P4). The same sequence is conducted on point (P3) with the distance (P3–P5), translating over the sides (P2–P3) and (P3–P4) of the square (P1P2–P3–P4) and obtains points P7 and P8. The distance (P5–P7) and (P6–P8) is the measurement of the side of the octagon. Points P9, P10, P11, and P12 are obtained by the reiteration of this measurement with a compass, whose marks can be observed on each point (Fig. 4).

4 The Geometry of the Layout of the Octagon

The layout of the dome of the parchment needs a method to draw the octagon (Fig. 5). Euclid's *Elements* (c.325–c.265 BC) (Heath 1908, 91–95) do not address the layout of the octagon based on the inscription of the octagon in the square, only appear some relation between the square and the circle in Books (IV.6), (IV.7), (IV.8) (IV.9). Ptolemy (c.85–165) in his *Almagest* (Toomer 1984, 35–74) also do not address the layout of the octagon. It appear in the Gromatic text *Fragmentum de hexagono et octogono*, which is attributed to Marcus Terentius Varro (116–27 BC)

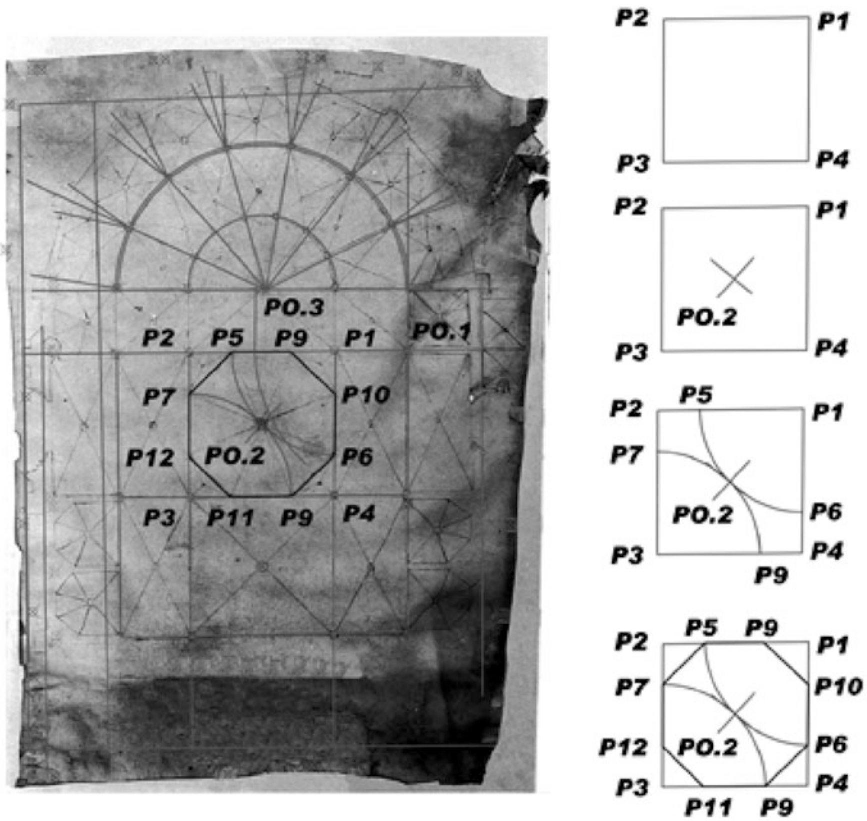

Fig. 4 Layout sequence of the octagon

(Bubnov 1899, 552). This text contains the drawing of the octagon through the iterative layout of eight perpendicular lines over the diameter of the circumference. This squaring method was widely used in Roman flooring (Watts 1996, 165–182). The problem was also considered by Hero of Alexandria (c.20–62) in his *Metrica* (LI.XVIII) (Schoene 1903, 57–59; Bruins 1964, 3). His method is considered a reference for the layout of some octagonal apses from the eighth part of the circumference using the triangle (13, 10, 13, h = 12) (Cantor 1907, 377–379; Özdural 2002, 217–242).

The method from Mohammad Abu'l-Wafa Al-Buzjani, (940–998) *en El libro de construcciones geométricas que son necesarios para los artesanos* (c.990) starts from the side with the same measure of compass (Chap. II.8). (Woepcke 1855, 330). The figure *mediatrix* of the *De triangulis* (c.1250) by Jordanus Nemonarius (1225–1260) (P.IV.15), *Octogonus circulo inscriptus inter quadratum eidem inscriptum et quadratum circumscriptum proportionali* (Beaujouan 1975, 453–454).

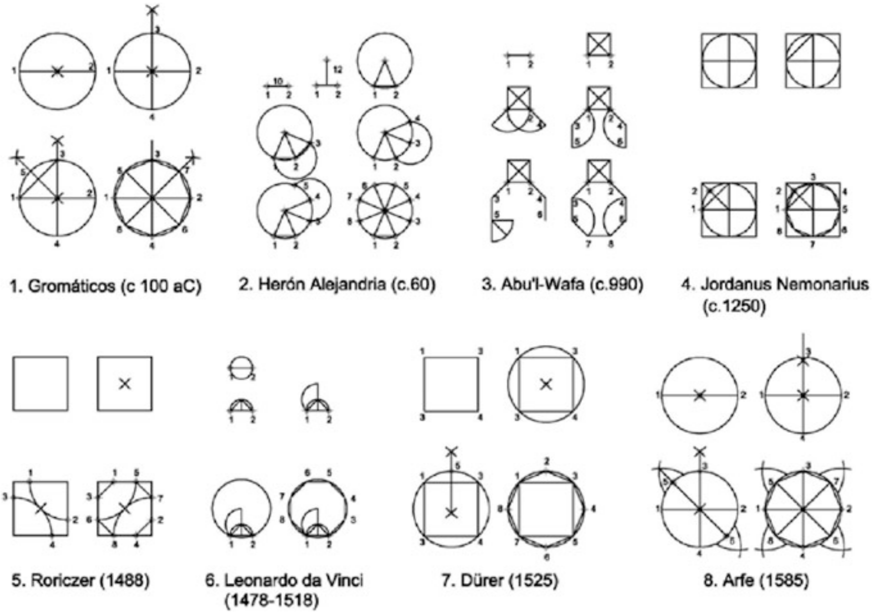

Fig. 5 Layout of the octagon *1* Gromatics (c.100 aC), *2* Hero of Alexandria (c.60), *3* Abu'l-Wafa (c.990), *4* Jordanus Nemonarius (c.1250), *5* Roriczer (1488), *6* Leonardo da Vinci (1478–1518), *7* Dürer (1525), *8* Arfe (1585)

The Gothic design of the octagon appeared in the *Geometrie Deutsch* (1488) (fol 3r.) by Matthaüs Roriczer (+c.1495). There it is drawn using the inscribed square and abates its semi-diagonal (Roriczer 1999, 56–60; Hoffstadt 1847, 20; Shelby 1977, 119–120; Recht 1980, 25), which is similar to the method WG 18 appearing in the Frankfurt album (1560–72) (Bucher 1979, 219). Luca Pacioli (1445–1517) uses a method of squaring the circle (Dist. 4. Cap2) in the *Summa de Aritmética, Geometría, Proportioni et Proporcionalità* (1494), which is similar to Nemonarius (Pacioli 1523, fol31v) and dedicates (Part.III.TI.C.39-40-41-42) of the *Divina proportione* (1497) to the octagon, where applies integer arithmetic ratios between the diameter and the side of the octagon (Pacioli 1509, III, 7r–7v).

Leonardo da Vinci (1452–1519) in the Windsor codex 12542 (1478–1518) constructs the circle that is inscribed on the side of the square of the isoptic of the side of the octagon (Reynolds 2008, 51–76). Albrecht Dürer (1471–1528) in the *Underweysung der Messung* (1525) uses the reiterated process for the partition of the side of the square with the compass. Otherwise, in the *Il Primo libro d'architettura* (1545) by Sebastiano Serlio (1475–c.1554) it is used the Roriczer method (Serlio 1545, 19). In the architectural manuscript (c.1545–1562) by Hernán Ruiz el joven (c.1514–1569) it is used also Serlio method (Navascués 1974, Lam. XXIII). Juan de Arfe (1535–1603) wrote *De varia commensvracion para la escvltvra y architectura* (1585), where he layouts the figure by using the circumference and its average arcs (LI.T1.C2.13) and octagon the inscribed in the square (LI.T1.C2.14) (Arfe 1585, 7v–8r).

5 The Gothic Modular Structure: Traça Verus Fabrica

An initial module makes the lace parchment. Guarç divided the width of the cathedral in six parts (91 mm), a measurement that is considered a unit pattern. The rectangle, next to the primary key of the presbytery, has a ratio of (91/82 mm). The proportion between the side chapel's width and the separation wall is 8/1 and makes the modulus of the side nave 9 units and the central one 18 units. In conclusion, Guarç uses the 18/8 numerical relationships between the nave and the side chapel or, what is the same, the tonal relationship 9/8 between the ambulatory and radial chapel.

The pattern of *Llibres d'Obra* (ACTo) is the *cana* of 8 spans, and the span of 12 fingers. The Tortosa's *cana* is defined in the (IX Book, Rubric 15.5) of the *Consuetudines Dertosae* (1272) (AHCTE, Arxiu Històric Comarcal Terres Ebre, cod.53, fol.256r) and the text *Costums Generals feutes de la insigne ciutat de Tortosa* (1346) (FBMPM, Fundación Bertomeu March Palma Mallorca, fol.100r). The unification of the Tortosa's *cana* to Barcelona's (24-VII-1593) was determined to be 1858 m (Fig. 6).

The Tortosa cathedral's apse has the metrological proportions of 150 spans wide, 100 spans deep and height, radial chapels with square floor plan of 21 × 21 spans, and the stake out of the axis of the pillars separated by 3 *cana* (24 palms).

The (9/8) ratio is the same between the Guarç's geometric layout and the general stake out of the radiating chapels of 24 spans wide and is drawn to 54 spans. The modular structure of Guarç's plan, from a geometric perspective, is the same executed work, and there is a need to apply a proportional factor for placing it. If Guarç's project had been executed, the scale value would be 3 (Fig. 7).

Because of the parchment's modular structure, it can be speculated as an arithmetic relationship that can carry, with certain comfort, the parchment's measurements to the work. The relation that Hero spread, which was based on the isosceles triangle angle (360/8) (13, 10, 13), actually (13.9, 9.50, 13), was known among the Gothic masters. In Guarç's case, the radial chapel floor plan is (8 × 7.5), and the dome is layout on the square (18 × 18). The octagon side is similar to the depth of the radial chapel (7.5), which is obviously an arithmetic approximation (7.456). Hero measurement errors, similar to Guarç's, are completely negligible in Gothic building measurements (Fig. 8).

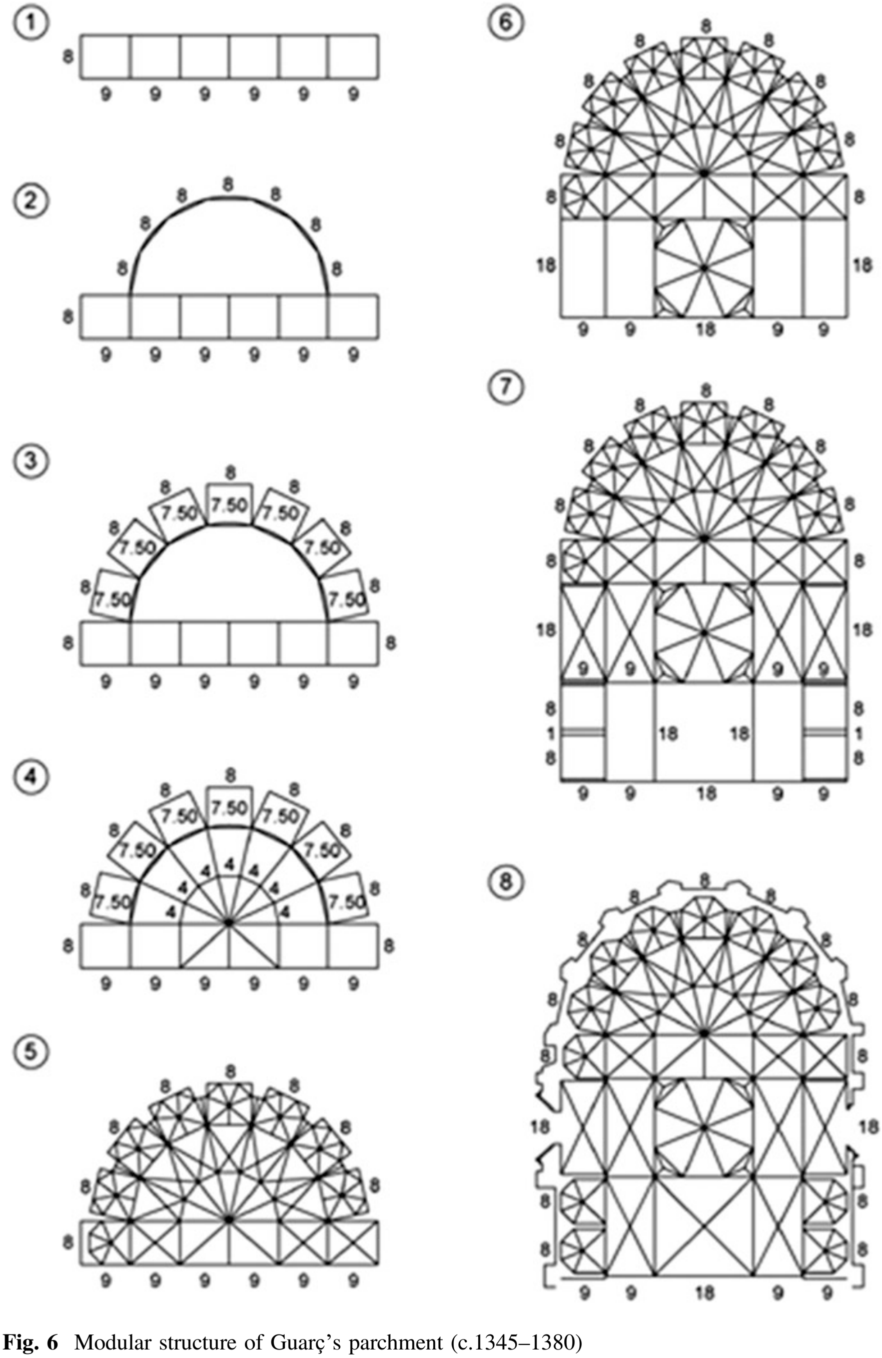

Fig. 6 Modular structure of Guarç's parchment (c.1345–1380)

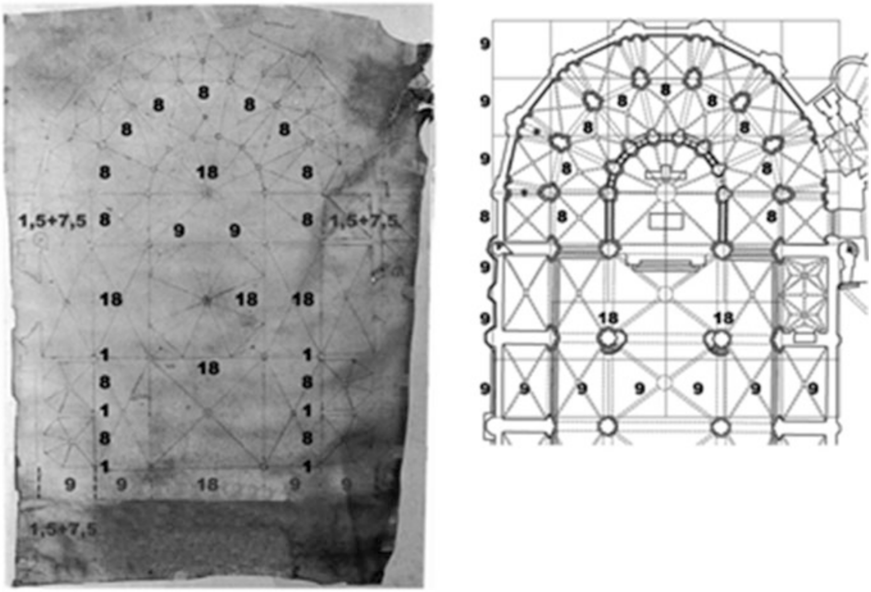

Fig. 7 Modular structure of Guarç's parchment and the Cathedral built (c.1345–1380)

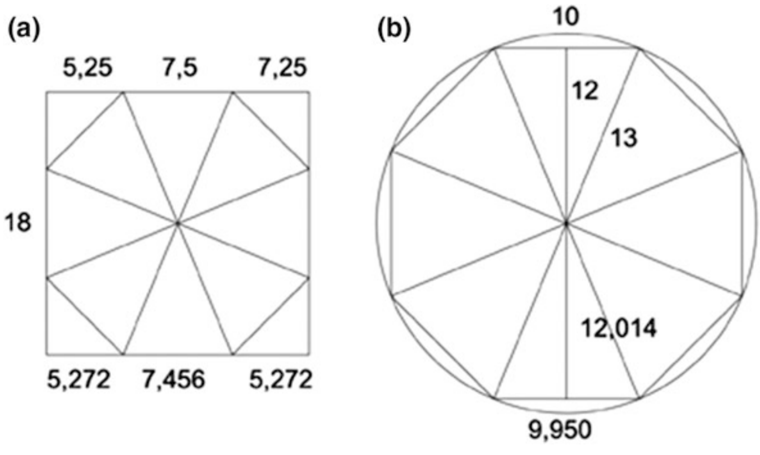

Fig. 8 Approaches to the figure of the octagon. **a** Guarç and **b** Hero of Alexandria

6 Conclusion

The geometric layout of the octagon used by Guarç (c.1345–1380) is similar to the layout published in *Geometrie Deutsch* (1486) by Matthaüs Roriczer (c.1435–1495). The *geometria fabrorum* in Guarç's layout will raise two basic issues.

On the one hand, the design layout is drawn geometrically with a compass. On the other hand, the masonry transposition will have a metrological and arithmetical nature. The parchment structural plan has an arithmetic base of nine and allows us to solve as an algorithm by integer numbers the design layout and its later use in the masonry.

Geometrical operations of the octagon drawing, posed with *circino* (Etym.XIX. XIX.19.10), allude to instrumentally immeasurable metrics. With a changed scale, the design must be moved to the masonry with a different instrument, such as the *linea* (Etym.XIX.18.3) and the *norma* (Etym.XIX.18.1) that must have a metrological base. The arithmetic transposition of Guarç's octagon over a square of base 18 and which side is 7.5 (the same as the depth of the radial chapel), has a *Metric* base in Hero of Alexandria.

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The Graphical Documentation Like Source of Investigation of the Architectural Heritage

Antonio Miguel Trallero Sanz

Abstract The architectural heritage forms an important part of cultural heritage. Though formed over the centuries, its concept and its interest in preserving are relatively new. Apart from the work itself, which sometimes are is a few remnants or memory, it is essential to know your surroundings. They are important to study them all documentary sources. Written documents normally have been studied in depth, but the graphic documentation has not been studied enough, something that corresponds to architects, who will analyze them from an architectural, constructive and urban point of view.

Keywords Draft · Drawing · Photo

1 Introduction

The architectural heritage forms an important part of cultural heritage. This heritage has been created through the centuries, nevertheless, the "concept" is relatively new since emerged in the nineteenth century[1] determined by the recognition given the same as a manifestation of culture and art of a certain time. The birth of this new concept involves conservation concern, its recovery, and even the knowledge of Heritage lost.

For any of these actions is essential to try to get to know both the artwork and the contributions has been receiving over the centuries, and the urban environment for which it was created or that it was created for it, being that this environment may constitute an inseparable part of the architectural work.

To get to know in depth this heritage is not enough to know the works as they have come down to us, often only its remains or its memory, but must use all

[1]Hernando (2004, 279–280).

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documentary sources that are available, but while written documentation it has typically been different and comprehensive studies mainly by historians and art historians, graphic documentation most of the time has not been studied enough or properly, thing that it has to make the Architect, analyzing it and obtaining architectural, constructive and urbanistic coherent conclusions.

Through this communication, using concrete examples, we intend to show the importance of various graphics documents which they have served to approach missing buildings and environments radically modified.

2 Graphics Documents

This first image corresponds to the environment of the Palace of Duques del Infantado in Guadalajara. This is a cut of plane 2 drawn by the Geographic and Statistical Institute directed by Ibáñez de Ibero, in 1880 (Fig. 1).

On this plane shown the floor of the Palace along with some of the public buildings in its environment. On its right you can see an old alley that separated from the ancient Church of Santiago, now disappeared, which accessed a small square, Santiago's Square, which also it comes from the High Street Lower, Miguel Fluiters Street today, which was also a narrow alley at the time, through which we reached the convent of Santa Clara, which, at present, only the chapel is preserved. It has become the parish church of Santiago after the demolition of the original.

The main facade of the palace was located in the Infantado's square, this facade is extended with auxiliary buildings of the palace itself, destroyed in 1936. The opposite side of the square was formed by the side wall of the Engineering

Fig. 1 *Guadalajara Plane* No 2, E: 1/1000. Geographic and Statistical Institute (1880)

Academy, destroyed by fire in 1924, that settled in what it was formerly Royal Textile Factory and before the palace of the Marqueses de Montesclaros.

The main facade of the Academy continues with the Church of the Convent of the Remedios and the facade of the Convent, converted into hospital, and he faced the Textile Factory's Square that closed on the opposite side to the Church of Santiago with the old Real Alcázar, converted into barracks and also it destroyed during the Civil War and preserved only a few remnants of its medieval structure.

If we compare this plane with the current state of the area, we can see how it has lost much of the built heritage of the city, in addition to the important change its urban layout consists of narrow streets and small squares, not so small in this area due to the importance of the buildings that formed their foreheads.

The graphic quality of Plane of the Geographic and Statistical Institute It gives an idea of the accuracy of this uprising, but if you look at the preparatory drawings, the drawings making data, made in 1878, there is no doubt about it.

The next plane corresponds to part of this environment and is completed with other areas. It can see how public spaces are triangulated and bounded, as well as all the constructive elements that face the same. Contours also are shown with their respective dimensions. The presence of all these data would indicate it have been measuring "in situ" by highly prepared, so thanks to them we have an accurate knowledge planimetric and altimetry of the city of Guadalajara the date on which it were made (Fig. 2).

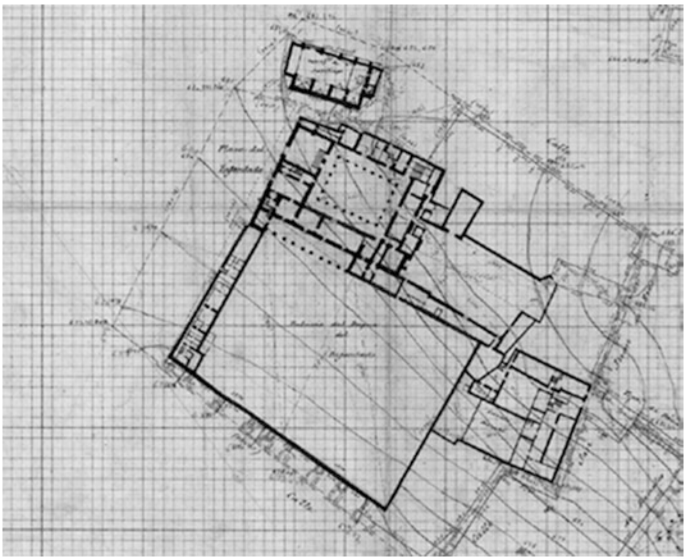

Fig. 2 *Topographic works, Town hall of Guadalajara, E: 1/1000.* Geographic and Statistical Institute (1878)

As we have seen, in these drawings many public buildings in the city are included, buildings that to be represented were premeasured and collected in other planes made on a larger scale.

Therefore, we have with this collection of drawings by the Geographic and Statistical Institute a priceless documents to meet the urban area of the city of Guadalajara with its layout and exact dimensions, with which we can know, at least in part, a large number of buildings currently missing.

Other interesting graphic documents, from the point of view of research of architectural heritage, are the drawings of travel, mainly of Architects, which it was the subject of previous Congress. Among these artists is Genaro Pérez Villamil that, despite not being an architect, he feels very attracted to the world of Architecture. In his work he highlights his drawings included in the Artistic and Monumental Spain, "*The most beautiful travel book lithographed the Spanish romance",*[2] however, these drawings, despite its quality, theirs suffer from inaccuracy, probably because they are works of "study" made from sketches from life.

These sketches, however, they constitute a source of first-hand information. Pérez Villaamil visited Guadalajara in 1837, that is, a few years before the completion of the work of the Geographic and Statistical Institute, and among others, takes three pictures of the ancient Church of Santiago.[3]

The parish church of Santiago was partially demolished in 1937 suppressing the chapels on the Gospel side, also demolishing the chapel of the Santísima Trinidad and the primitive apse,[4] (Fig. 3) after these demolitions that, among other things, they served to expand in this area the narrow alley that was Main Street Lower, the orientation of the temple is changed by placing the head in what had been the feet, next to the tower.

If the planes of Ibanez Ibero, together with some other documents such as photography of Diges from Church in which the tower and the arc that communicated with the Palacio del Infantado are seen, or drawings of Rico 1864 or of Pascó 1885, they help us to approach the knowledge of this building after partial mutilation until its completely demolished in 1903, this Villaamil's drawing us closer to the original temple, to its constructive and formal model, while it confi the representation that makes Anton Van der Wyngaerde in 1565.

Anton Van der Wyngaerde was a Flemish artist that, commissioned by Felipe II made the views of the main Spanish cities. In the illustrated that he makes of Guadalajara, which is the oldest preserved city graphic document, builds on an unrealistic view high point, since in this area there are no elevations, located on the right bank of the river Henares (Fig. 4).

Another traveler was English artist Richard Ford, who after moving to live in Spain in 1830, he traveled performing more than 500 drawings. During his visit to Guadalajara he draw the facade of the Palacio del Infantado and the head of the

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2 Museo Nacional Del Prado. Enc. online. Pérez Villaamil y Duguet, Genaro.

3 Trallero (2014, 671–672).

4 Trallero (2015a, b, 248–257).

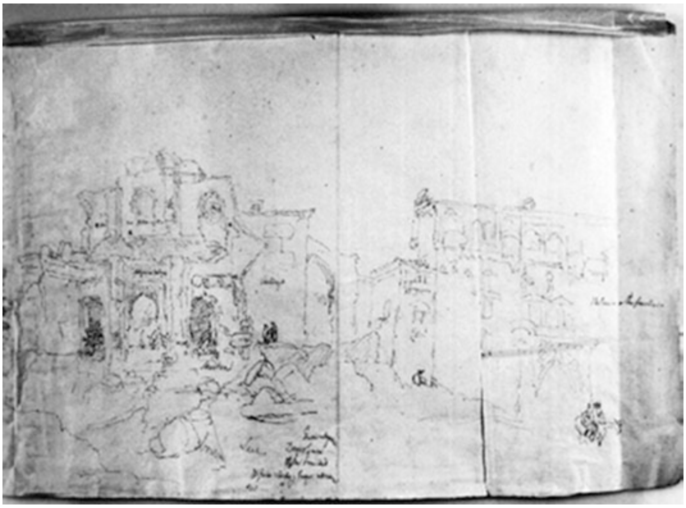

Fig. 3 *Palace of the Infantry and demolition of the Trinity*. Jenaro Pérez Villaamil, 1837 (?), National Museum of Sculpture (http://museosangregorio.mcu.es). Culture Ministry

Church of Santiago (Fig. 5) which is the only known image of the same apart from the Villaamil during demolition.[5]

Apart from planes and drawings are also important as a documentary source the historical photographs that can be preserved, not only because they show us the image of the building but also represented by the data can be obtained from them after a detailed analysis. As an example I want to expose the other of the missing medieval temples of Guadalajara, the church of San Gil, one of the ten parishes which had the city since the Middle Ages.

After his removal as a parish and after several previous attempts demolition, finally after the collapse of the atrium in 1924 and it be declared a Historic Artistic Monument,[6] It was demolished for being considered the seventeenth century. In principle it is proposed the conservation of the Orozco's Chapel considering it part of the original building and the main door at the foot of the Church since after the collapse of the atrium wall revealed and it was proven that it was the original temple XIII century. This gate was proposed removal and transfer to another place. In another graphic document of the time it comes to propose a performance to relocate this door a little "quaint".[7] Finally, both the Chapel of Orozco as the front door were demolished and only the apse of the church was saved by having become part of the

[5]Gamir (2014, 273).

[6]*Oficio de traslado del Subsecretario del Ministerio de Instrucción Pública y Bellas Artes de Real Orden por la que se declara Monumento Arquitectónico-Artístico la iglesia de San Gil de Guadalajara*. Real Academia de la Historia. Exp: CAGU/9/7956/19(2).

[7]*Plaza de San Gil*. Semanario Renovación. 15-X-1926.

Fig. 4 Guadalajara's view. Detail. Antón Van der Wyngaerden (1565)

Fig. 5 Santiago's Church. Richard Ford

structure of some adjacent buildings. This is a seventeenth century Mudéjar apse and Romanesque tradition that, despite being part of the original temple, at no time raised their conservation.

There are some photographs that capture the external image of the temple and the demolition process of the building from the sinking of the outer court (Fig. 6). Thanks to these photographs is known how was the image inside the temple at the time of its demolition and relying on the ground of the church included in the planes for the city of Guadalajara Geographic and Cadastral Institute, which as noted above, they are perfectly dimensioned with measures taken "in situ" and even data from the few remains still preserved, It could make a drawing of floor planes, elevations and sections of this Church, it was the subject of Work of Thesis in the School of Technical Architecture of the University of Alcalá.[8]

Apart from the external information about the interior and exterior aspect of the building, these photographs also provide important information about the construction system used, which it has served to conclude that the temple demolished in the early twentieth century was not a building of the seventeenth century that had preserved some of the elements of the original building, but rather it was the original building, that probably would have been some partial demolition but was basically primitive who had suffered a complete internal transformation, and a minor extent also external. A process of "Baroque transformation", similar to that followed by the nearby and very near, from the architectural point of view and constructive, Church of Santa María, or also suffered from other Moorish temples of the city as the Church of Santo Tomé, thereafter Sanctuary of Nuestra Señora de la Antigua, or the convent church of Santa Clara, now parish church of Santiago.[9]

According to the plane of the Geographic and Statistics Institute and this picture of the interior, This was a temple of a single nave with side chapels, topped by an apse preceded by a presbytery with a vault of average orange with a flashlight to illuminate it interiorly, however, Thanks to information from these photographs came to the conclusion that was originally a Moorish temple of three ships, separated by arches, where the main nave is remated by a barrel-vaulted presbytery, replaced by the half orange, and a semicircular apse, and it was transformed, without demolish it, in a baroque temple.

Other documents extremely important are projects, and within them especially their planes. Parish of Santo Tome was another suppressed in the nineteenth century in Guadalajara, however, contrary to what happened with other parish churches, it was not demolished but rather became the Sanctuary of the Virgen de la Antigua, patron of the city.

Due to the poor condition in which the building was, after a partial renovation in 1885 by the municipal architect Mariano Medarde projected an "ambitious" work of reform, than by economic problems it was never executed (Fig. 7).

In 1893 he was commissioned a new more modest project to the diocesan architect D. Juan García Ramirez, that also not executed, and then, in 1894 another to the Provincial Architect Benito Ramón Cura[10] that it was carried out, at least partially. In this last project, the demolition of the original temple was proposed and also it included the construction of one new plant of a single ship that changed the original orientation, being its apse in place of the feet. Probably for reasons of worship it is not totally demolished the primitive Church, leaving the apse and the presbytery in the feet and various side chapels. Although it not preserved this project and therefore is unknown how would finished the ship, by unions bricks of

[8]*Levantamiento de la Iglesia de San Gil*. Fernando Vega Todolí. TFC. EATUA.

[9]Trallero (2015a, b, 106–129).

[10]Trallero et al. (2011, 74–75).

Fig. 6 *Church of San Gil. Demolition process.* Foto Goñi (AGA)

the new ship, it follows that, it was planned the demolition of the Mudéjar apse of the Church of Santo Tomé.

Reference was made to the "ambitious" reform project by Mariano Medarde. In this project the primitive Mudejar temple converted into a different neomudejar replacing the vaults of the head, the Romanesque tradition, by other neogothic, changing the arches of communication between ships with new decorations and building a tower-atrium that reproduces the Toledo models, on the outside.

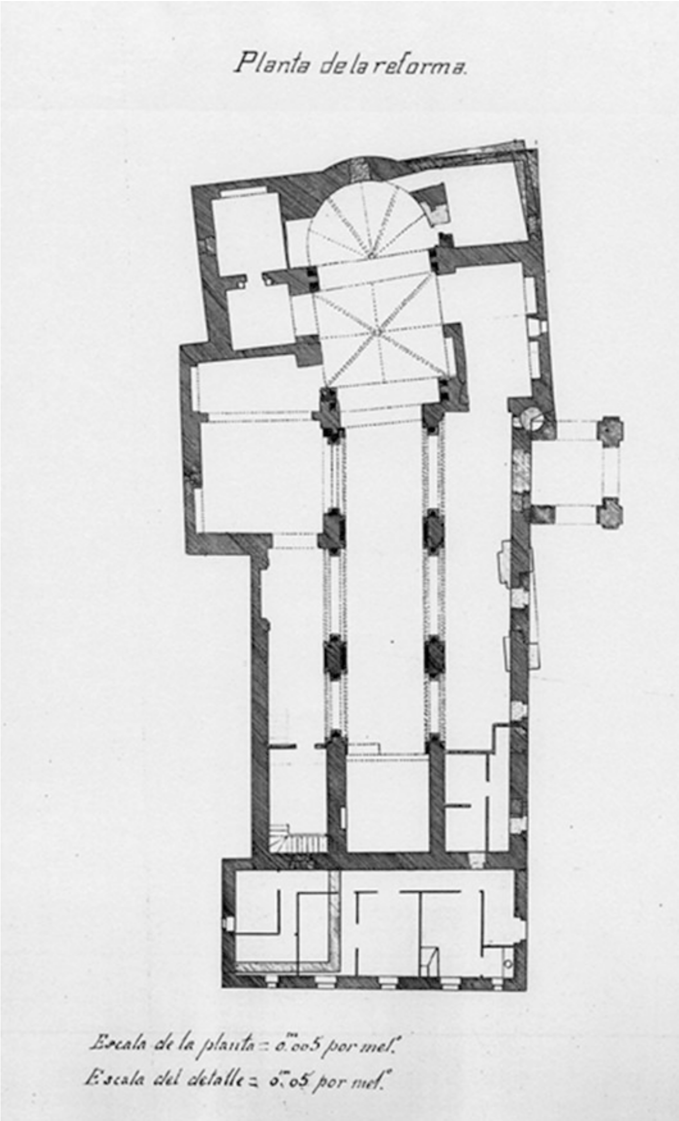

Fig. 7 *Plane of the Antigua's Church. Mariano Medarde* (1885). AHGU

The planes for this project are very interesting not only for the information provided by the proposed action but also because they include data from the original building, subsequently demolished.

The original plane of this temple is known from the planes of the Geographic and Statistical Institute, where its dimensions are included. It also has exterior views such as drawings Salcedo 1870, Pascó 1885 and 1891 Juan Diges, and an inside view, also Salcedo, 1870 in which you see a church has three naves with a structure of pair and knuckle in the central nave and different structure in the side aisles where the arches that separates them, as in other temples have been suffered a slight Baroque transformation. We can also observe the Gospel side chapels that were preserved in the demolition, and the old apse now it located at the foot. In the drawings of Medarde, using different graphics, it is shown superposed the original state and the end, providing additional information, extremely precise, which allowed, together with the other information and measurements of the preserved parts, a virtual reconstruction of the Church before its demolition.[11]

The Church of San Esteban also underwent a process of partial mutilation to finally be completely demolished. We have an exact knowledge of the plant in 1878 thanks to the planes of the Geographic and Statistical Institute, at that time it had already been removed as a parish and had moved to her and a few adjacent buildings the community of Jerónimas nuns.

At this plane the Church is represented as a building of three ships, with a straight but oblique head, the result of the mutilation of the head, with annexed buildings for convent.

In the Historical Archives of the City of Guadalajara planes sanitation and dated alignments in 1867 they are preserved, therefore prior to the Geographic and Statistical Institute. At this level include the alignment of the Church and in it and an atrium of 1878 has disappeared. Another important difference is the alignment that corresponds to the head of the Church that is an extension of the alignment of the Convent, the proposed new alignment that coincides with the boundary of the temple in 1878, indicating that it was modified to fit the new official alignment, which did not happen with the facade of the Convent (Fig. 8).

This is the plane of Guadalajara drawn seven years ago (1860) by Francisco Coello. On this level is reflected the profile of the Church of San Esteban that is finished off by two semicircular figures, the biggest could correspond to a semicircular apse would top the nave of the Church, and the smallest could be the apse of a side chapel to serve as a lateral end of the outer court the collected in the plane of 1867, which also is reflected in this plane (Fig. 9).

The Foundation Lázaro Galdiano is preserved a drawing of Valentine Carderera titled Parish Church of San Esteban, without indicating what city is it. It is described as follows: View of the church showing, in a first plane, Mudéjar apse of semicircular plant and in the background, the tower. To the right, a fountain with several women. It is dated between 1820 and 1880.

Undoubtedly it is the Church of San Esteban in Guadalajara. The two apses are represented in the plane of Coello in the passage between the Mail Square, now San Esteban Square, and San Esteban Square today General Prim Square. The fountain with women is what is represented in the Square of San Esteban on the plane of Coello, on the plane of alignments and on the plane of Geographic and Statistical Institute (Fig. 10).

[11]Trallero et al. (2011, 51–57 y 61–67d).

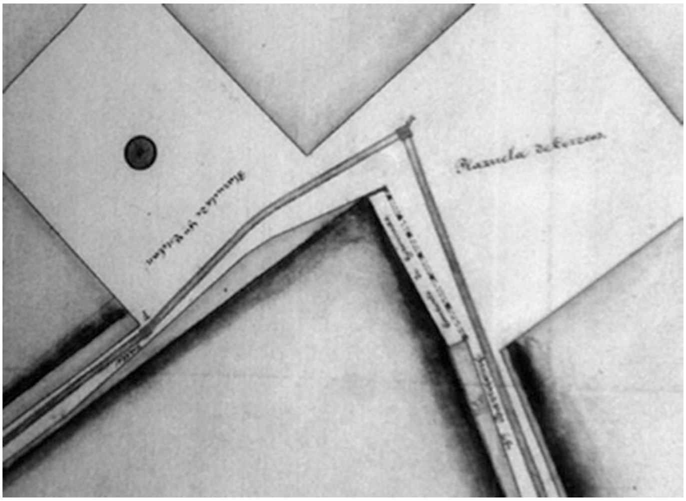

Fig. 8 Alignments and sanitation (1867). AHGU

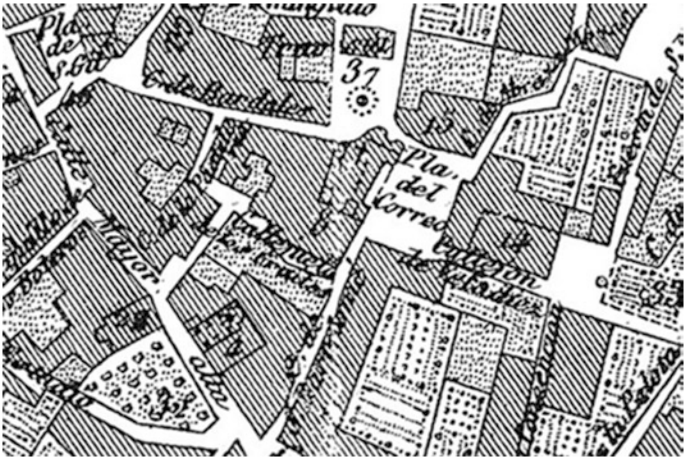

Fig. 9 *Guadalajara*. Detail. 1860. Francisco Coello

This drawing complete information on the development of this temple. Obviously it was a Moorish building, at least as it regards its apse, similar to the nearby Church of San Gil, and the presbytery. The ships of the temple excel in height above the Presbytery and, occupying part of the ship of the Gospel, the tower. With the data available it can not determine whether the ships are for the original temple or postdate.

After the demolition of the apse, the presbytery and the chapel which closed the atrium, alignment indicated on the plane of sanitation indicates that the first tranche

Fig. 10 *Parish church of San Esteban*. 1860. Valentín Carderera

of the ships of the Church remained and subsequently, to adapt it to the new line a new space a new wall was built which reduced the space and it was assigned, after separating from ships through a partition wall, as a home for goods of the Church.

3 Conclusions

The different graphics documents preserved of a building constitute an important documentary source to get to know as deeply as possible, but the information can be obtained from them is not immediate.

First study the document itself is necessary, analyze their fidelity and graphic quality to meet up to what point may be reliable data contained in them, because sometimes items are collected that, can improve the artistic quality of the document itself, they distort reality represented and secondly, should analyze all the data for the corresponding construction and urban conclusions, being the architect the professional best placed to do so.

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Design Drawings: Traditionalism and Renewal. Drawings by the Aschieri Group for the Competition for the Arts & Crafts District in Rome in 1926

Fabio Lanfranchi

Abstract To assess architectural drawings should respect precise rules and codes is an obvious consideration, nevertheless, analyzing any projects graphics, we can find drawings with considerable *ambiguity of expression*. In the climate of the Twenties in Italy, we believe that matter assumes a particular value both for the strong impulse to change that for the difficulty the abandonment of historicist styles and modes. This contribution, relate to analysis of the project winner of the competition for the Quartiere dell'Artigianato of Rome, can represent one between the possible interpretations of the slow decline of the way of thinking and drawing architecture.

Keywords Drawing · Language · *Quartiere dell'Artigianato* of Rome

1 The Historical Context: Architecture Used by the Fascist Regime as a Propaganda Tool

Rarely has it been so easy to judge a competition: with a design that outshines all the rest, choosing it is a foregone conclusion. Why? Firstly, a general consideration: it's time we stopped choosing all those picturesque, decorative hackneyed designs that many young Roman architects are so proud of. Architecture is a serious issue; it cannot be tackled and accomplished by those who wish to muddle through using small arabesques, tympana, windows, mouldings and ashlars. Their continued use means relapsing into trite nineteenth-century decorations—an unhappy and cursed memory (Papini 1926, 67).

This pompous, verbose citation illustrates the contemporary cultural and architectural climate in Italy, and especially in Rome. Zucca's opinion about the Capitolium has a different tone, but it still has a propagandistic narrative emphasis:

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"Gone are the days when each and every competition was melancholically declared null and void. I repeat: in Italy the atmosphere is changing in favour of great art. I repeat that architecture/great architecture is emerging in leaps and bounds in Italy, that there is a lusty reflourishing which is not just a promise, but a fact: an undeniable, important fact" (Zucca 1927, 579).

The 1926 Competition for the Arts & Crafts District was launched by the Istituto per le Case Popolari (Council Housing Institute) on behalf of the Governor of Rome and under the auspices of the Artistic Association of Architecture Enthusiasts: "The initiative, which will be rapidly implemented thanks to the enlightened intentions of the National Government, has the following objectives: generate a centre of development and propaganda of individual art; create a peaceful, happy environment in which the craftsmen can design, execute and build an object of beauty with their own hands; draw the attention of visitors, enthusiasts and traders to this characteristic and picturesque centre" (Calza-Bini 1926). Architecture thus became a tool for institutional propaganda, in this case, the design of a site dedicated primarily to artisanal activities. The project was in line with the guidelines of the Regime in favour of suppressing what it called: "The old individualistic approach of the inventive craftsman, replacing it with the new associative approach given that life's necessities require different creators to be interconnected. In fact, the scholastic education/training of a craftsman has already been the object of broad-ranging, intelligent provisions" (Zucca 1927, 579–580).

Corporatism and reference to the reform of the educational system (implemented a few years earlier thanks to measures contained in the Gentile Reform), confirm the attention afforded to this sector by Italian institutions. The architectural and cultural context referred to earlier corresponds to the first of the two periods of the twenty-year rule by the Fascists, historically established by De Felice[1] and architecturally declared by Spagnesi: "The first period between 1921 and 1929 involved the transformation and enlargement of Rome, still partly with nineteenth-century ideas; the second, between 1929 and 1940 […] involved further transformation and upgrading of the city to adapt it to the complex, extensive phenomena of a big, contemporary western capital" (Spagnesi 2007, 355). Having briefly described the context I believe that this competition is one of the first, emblematic examples of a new political trend increasingly focused on demagogy as a way to obtain consensus. Architecture became a symbol embodying a precise political position. Although it was never implemented, the project was a propositional manifesto. The formal design of the site area sparked a huge debate focusing chiefly on the need for institutional research and suitable celebrative styles for the new Regime. The first step in a trend that in Rome alone was to lead to the construction of the University Campus and the 1942 Universal Exposition.

[1]Renzo De Felice establishes two different periods during the twenty years of Fascist rule: the first between 1921 and 1929 coincides with the gradual rise to power and the beginning of the Fascist regime, and a second period between 1929 and 1940 characterised by popular consensus regarding Italy's entry into war.

2 The Competition for the Arts & Crafts District: From the Contract Notice to the Submissions

The contract notice for the competition provided numerous indications regarding envisaged functions, artisanal activities and urban planning issues; the style of the design was left entirely to the participants who were required to present: a general plan on a 1:500 scale; plans, elevations and sections on a 1:200 scale; a bird's-eye view to provide an overall image; as well as detailed views.

Submissions had to be presented on 31 August 1926; that day professional groups and individuals submitted a total of twelve proposals. Even before it began its task the Commission[2] examined a complaint lodged by one of the competitors alleging that several participants had submitted too many drawings, and that more or less detailed representations should be irrelevant and not infl ence the judge's opinion of the projects. The complaint was unanimously rejected. It's important to remember that two of the members of the competition commission were Marcello Piacentini (the Regime's future political contact person for architecture and founder and director of the magazine Architettura e Arti Decorative[3]) and Alberto Calza-Bini, organiser and Secretary General of the National Union of Architects, and later director of the aforementioned magazine).

Architecture in the early twenties, especially in Rome, was still extensively permeated by eclectic graphical and compositional pleonasms. The design drawings produced for numerous competitions—especially institutional competitions—still revealed designers' inability to distance themselves from the compositional style and representative methods they had inherited from the late nineteenth century; these styles and methods were no longer acceptable as they did not conform to the celebratory requirements of the new era. It's interesting to note how Aschieri, coordinator of the winning group,[4] "with an approach permeated by the nineteenth-century 'cult of formal continuity' was nonchalantly in contact with several artistic milieu (…) and how in architecture he actively searched for comparison with Italian and European culture in order to eliminate the cultural isolation of the Roman milieu" (Fazzino 1977, 36).

As mentioned earlier, the project that was to be "rapidly implemented" never saw the light of day. In 1935 part of the site set aside for the project was occupied by the post office building designed by Adalberto Libera and Mario De Renzi, while

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[2]Members of the commission: Arch. Alberto Calza Bini, the engineer Giuseppe Caffarelli (Governor of Rome), Arch. Marcello Piacentini, the engineer Innocenzo Costantini (Istituto Case Popolari) and Arch. Ghino Venturi (Associazione per i Cultori dell'Architettura).

[3]In 1921 Marcello Piacentini and Gustavo Giovannoni founded the magazine *Architettura e Arti Decorative* published up until 1931.

[4]Members of the group: Pietro Aschieri, Luigi Ciarrocchi, Mario De Renzi, Mario Marchi, Costantino Vetriani and Giuseppe Wittinch.

in 1937 the residual area became the site used in the second degree contract notice for the Casa Littoria design competition.[5]

Referring back to the aforementioned "institutional expectations", one of the possible reasons for the commission's decision might have been the fact that the winning group had adopted new styles based on the re-elaboration of revolutionary Italian approaches inspired by the architectural studies performed by northern European cultural avant-garde. These ideas were shrewdly transmitted thanks to the unquestionable graphic skills of the members of the group, first and foremost its coordinator. However, Aschieri's openness towards events taking place outside Italy actually led to his isolation from the mainstream a little later.

In 1927 Aschieri participated in the International Exposition of the German Werkbund with his project for the Arts & Crafts District.[6] In 1931 the project was also displayed at the M.I.A.R. exhibition[7] at the Galleria Bardi in Via Veneto. "This period coincided with the initial hostilities towards the official world of culture represented not only by Piacentini, Calza-Bini, etc., but also by the young architects of the R.A.M.I. (…) and all his collaborators in the now disbanded 'Gruppo Aschieri' (…) evidently less willing to run the same risks" (Fazzino 1977, 41). His involvement with the M.I.A.R. gradually led to his forced estrangement from the professional opportunities best suited to his skills and talents. Early warning signs of this situation had actually begun in 1927 and 1928 when he was replaced by Piacentini after having won the competition for the Palazzo delle Corporazioni in Via Veneto in Rome and the competition for the elaboration of the Brescia Town Planning Scheme.

3 The Design Drawings: From the Project Drawing to Its Representation

"Representative Ambiguities" (Lanfranchi 2012, 516) are present in the competition often drawings; the ones presented by the Aschieri Group are no exception. These anomalies involve the conventional method of representing both contents and projections. Sometimes these ambiguities depend on different interpretations by group members who, in a short space of time, are forced to work very quickly and hence execute the drawings rather hastily: this drawback is typical of competitions. However, the ambiguities may also be intentional differences strategically represented to make communication more concise, clear and therefore effective. In this

[5]In this case, too, nothing came of the competition. As we all know, Mussolini decided that the new area was to be the Foro Italico.

[6]This news was reported by the Giornale d'Italia on 27 July 1927.

[7]The M.I.A.R. was founded in 1930 and became the official voice of the Italian rationalist movement. In 1931, in opposition to the M.I.A.R. Piacentini founded the R.A.M.I. under the patronage of the Fascist Union of Architects.

particular case it involves the biased projective correspondence between the plan and elevations; this projective difference was probably adopted to provide simplifi communication regarding the architectural layout characterised by a complicated plan.

For example, the last building to the left of the block on the side of Viale Aventino (Figs. 1 and 2), but also the lack of correspondence of the last buildings on either side assigned to inlayers and engravers which differ from the plan in length and shape (Fig. 3 section RQ). Likewise the building for tapestry makers, the last building to the left in Fig. 3 section IL, where the façade of the last building is completely missing and which instead should have been accidentally projected.

The elimination of the water tank present together with the chimneys in section GM in Fig. 2 is another strategic "omission" implemented to enhance the

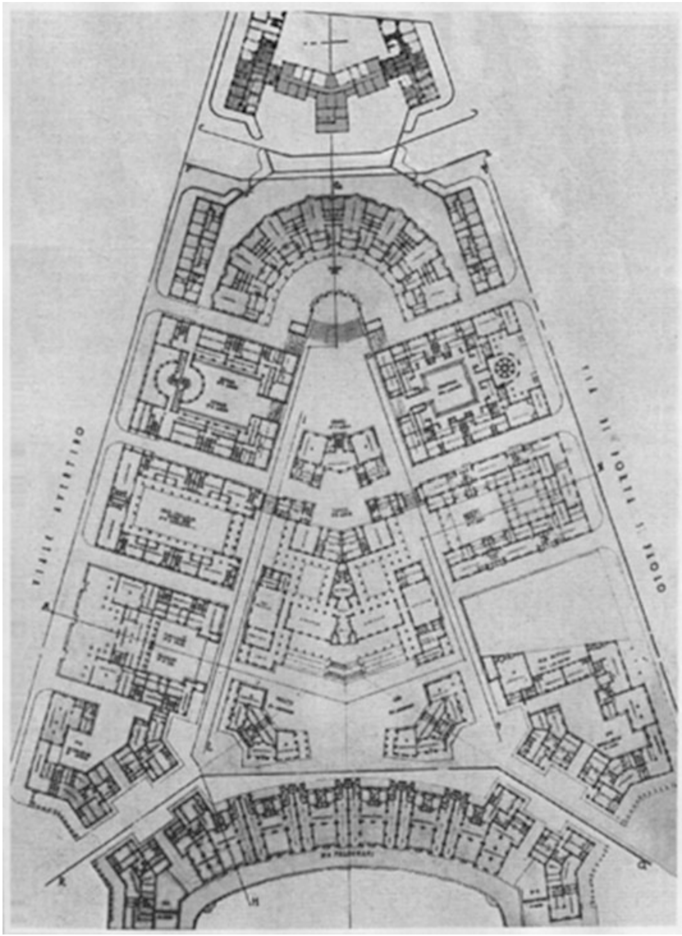

Fig. 1 Gruppo Aschieri, Competition for the Arts & Crafts District, Rome 1926. General Plan. Scale, 1:500

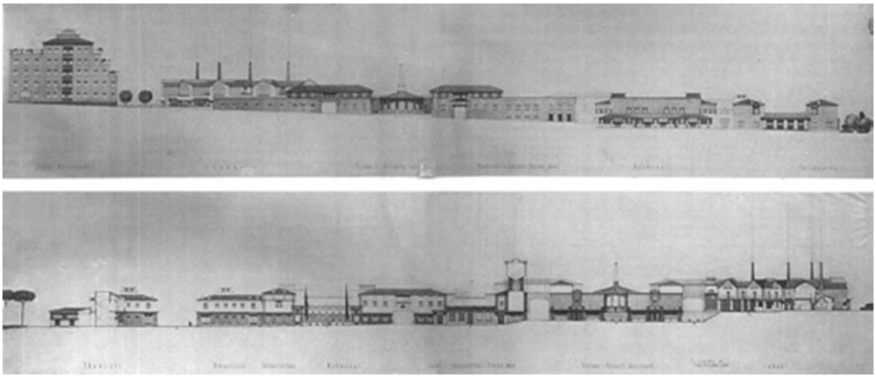

Fig. 2 Gruppo Aschieri, Rome 1926. Elevation along viale. Aventino (*above*) and section GM (*below*). Scale, 1:200

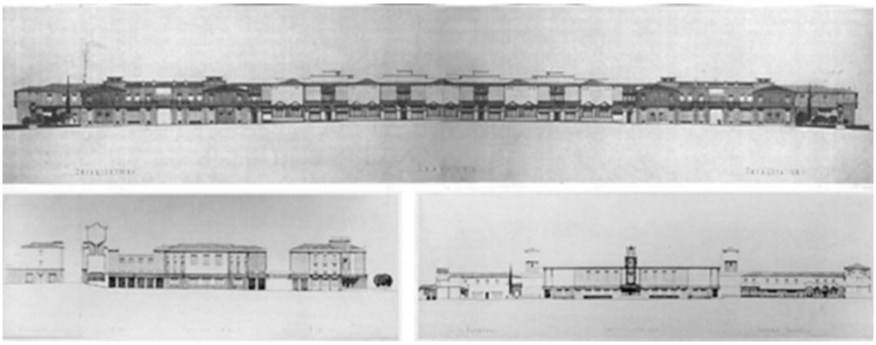

Fig. 3 Gruppo Aschieri, Rome 1926. Section RQ (*above*), section IL (*below*, *right*) and section AN (*below*, *left*). Scale, 1:200

"interpretation" of the design philosophy (in this case to emphasise the ribbon-shape of the low volumes along Viale Aventino). The reason for the omission is quite obvious: the architectural mass "hinders" the display of the structure. Instead the form and size of the slender chimneys, represented and emphasised as wispy columns of smoke, help to allusively "measure" the limited height of the façade along the street. Other representative anomalies are the omission of graphic lines defining the indirect projections and occasional inconsistency between the direction of the view (indicated by the position of the letters) and the projected section. In fact, the plan has no hatching or graphic signs indicating the numerous overhead crossing points that instead are a salient feature of the entire design layout; as regards the directions of the sections, there is also an inconsistency between the section symbol GM and its relative elevation.

Further study of the drawings shows that greater consideration should be given to the graphic signs used in the plans. Although the general plan is represented on a 1:500 scale, it has more signs than normal in that kind of plan. The same applies to the sections and elevations which in some cases provide details more suited to a smaller scale of representation. Obviously this could also be due to the authors' attempt to provide the best possible communication, including in terms of content, compared to the scale specifi in the contract notice. Whatever the case may be, the graphics are extremely clear; these skilfully executed graphics provide several images of each building while the use of chiaroscuro surfaces bestows on each architectural element a different and intentionally symbolic trait, executed with the means available and adopting a strictly scenographic philosophy (Fig. 3, section RQ). The same methods were also used for the corpus of the three-dimensional graphics and double projection drawings.

Another deviation from consolidated historical methods involves the envelope lines of the sectioned contours; drawn with restrained graphic intensity; the sections of the water tanks, and any other sectioned element, are dematerialised and merge with the projection lines so as to avoid distracting the observer from the overall represented context (Fig. 3, section AN).

Zenithal shadows are a characteristic of all the elevations. Plausible justification for this kind of projection lies in the compositional philosophy: a rigorous symmetrical layout repeated in each block. The modulated use of shadow, in synergy with and similar to the way in which the wall partitions are drawn, has a meticulous hierarchy thanks to the use of several nuanced colours; the structure of this hierarchy depends on whether the represented planes are closer or further away from the observer, as well as on the depth of single elements such as projecting parts or recesses.

Whether part of the embellishments or used as a volumetric emphasis, the shadows scenically define the architecture and become a main feature of the representation. From compact nineteenth-century wings to new design methods, shadows in all shapes and forms were soon to become a tool to achieve the shift from an iconic to symbolic representation. Graphic techniques, such as charcoal, watercolour and then tempera, were the accomplices of this new way of designing/representing architecture; they were to define a new way of designing architecture and the city (Fig. 4).

Going back to the general representation, it's important to point out how most of the graphic images almost never reveal the signature traits of the individuals who drew them. The result is a unison effect very similar to the music made by a group of musicians, i.e., at a time when quiet individualism becomes an important contribution to the successful outcome of the joint effort.

Reference is made here to the personal, expressive methods linguistically similar to the ones used in poetics. Unlike prose—necessarily traditional and conventional—the way this poetics is expressed allows it to use its own vocabulary, its own "metrics". In poetry, one's own—personal—language may be characterised by a

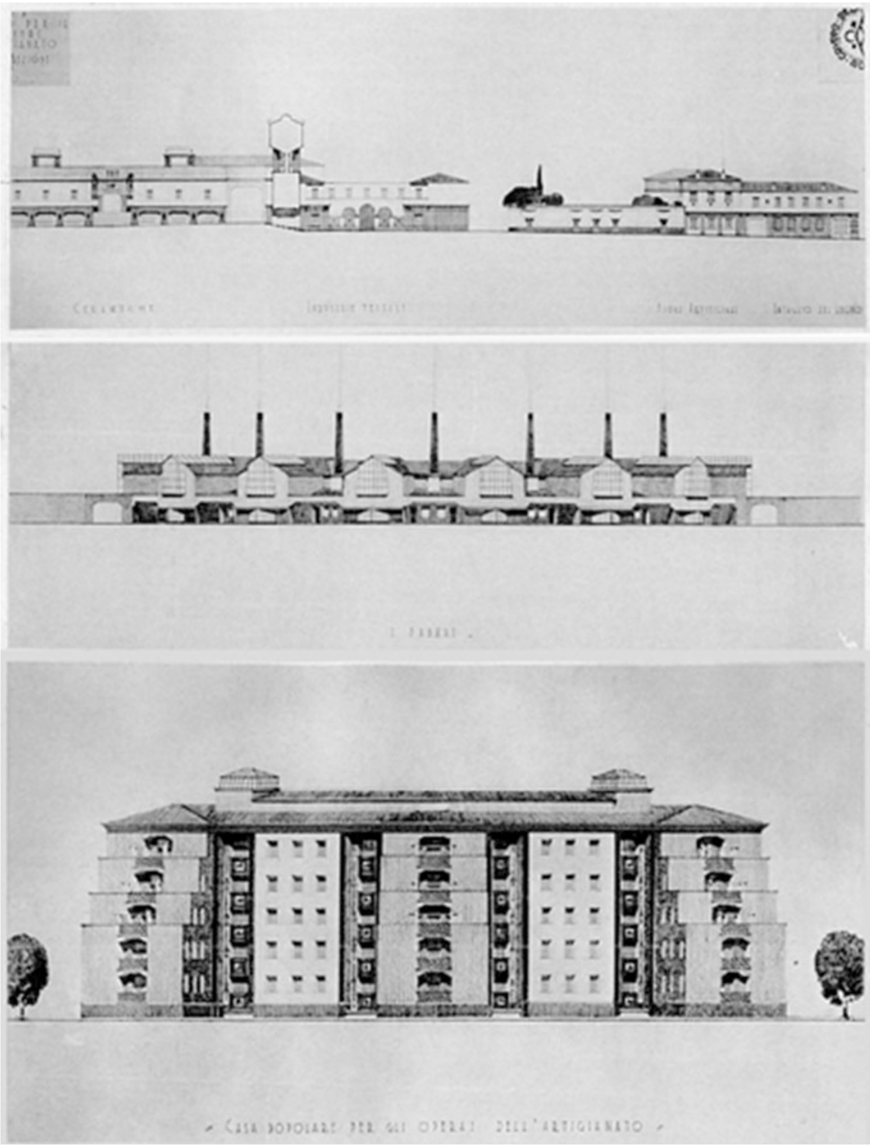

Fig. 4 Gruppo Aschieri, Rome 1926. Section OP (*above*), section FE (*centre*) and elevation of the council housing unites (*below*). Scale, 1:200

series of derogations to conventional expressive codes, the so-called poetic licences which on the one hand tend to diminish the expressive perfection of prose, but on the other bring the compositional outcome closer to the emotive, emotional and evocative characteristics intimately inherent in music.

The perspective views[8] reveal several fixed traits regarding, in particular, the expressive method and "angles" of the images (Fig. 5). The "wolf"[9] and watercolour techniques used in these drawings reveal the uninhibited cockiness of the authors' use of chiaroscuro, always characterised by a calibrated, alternate use of shadow and light (Fig. 6).

Aschieri himself writes: "If in some works the scene has to create a real environment, in others it has to be reduced to a minimum; it has to be … nothing more than a comment" (Valeriani 1977, 79). Valeriani goes on: "By introducing a comment to the stage set, Aschieri himself explicitly expresses the two aspects encompassing all his scenographic activity (…). Drawing as a desire to communicate, whether it involves the dark shades of charcoal, the alternate brightness of graphite or the wide softness of tempera. Represented data is extremely important in his stage sets and rough sketches, while in drawings the work is already complete; his drawn architectures are completed architectures" (Valeriani 1977, 79–81).

It's interesting to note how the projective viewpoint in the perspective reveals a rather significant "carelessness" towards the rules of descriptive geometry. Aschieri's ability to control the volumetric shape and relative architectural scene betrays his profession as a stage designer; it also gives the image a certain style similar to a graphic signature. The geometric reconstructions[10] (Figs. 7 and 8) reveal his habit of placing the horizon line quite low down in the image, as well as his ability to make several horizons with their relative viewpoints work together. These representations emphasise the composition and, at the same time, allude to a time-space situation closer to a real-life perception of the scene rather than simply to a study on paper. The scenic structures also include a reference to the urban wings represented using shadows created by the sun behind the viewer, as in Fig. 6, or thanks to crisp allusions to the outlines of the buildings—as in Fig. 9—disguised as prosceniums. The latter's main task is to frame, envelope, "measure" and emphasise the central part of the composition.

The perspectives also reveal several ambiguities especially regarding formal correspondence between the represented architectures: i.e., the ones caused by problems involving input by the group and the ambiguities created by the competition procedures.

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[8]All the drawings in this essay come from the archives of the Accademia di San Luca in the holding: Aschieri donation, box B, envelope C.

[9]A hard carbon pencil.

[10]Analysis of the perspective views made it possible to pinpoint the various observation points which, as shown in the plan, are all compatible with the represented areas (except the image with the letter D). The D and E views have a narrow visual cone compared to all the others. As regards the way the drawings were "built", note the position of the very low horizon line for perspectives A, D and F. Also note the graphic rendering of the architectural masses in images A, D and F achieved by using sev- eral vanishing points based on relative horizon lines; the same method was used for images A and C, but in this case it defines the subordinate elements such as intradoses, mouldings, etc.

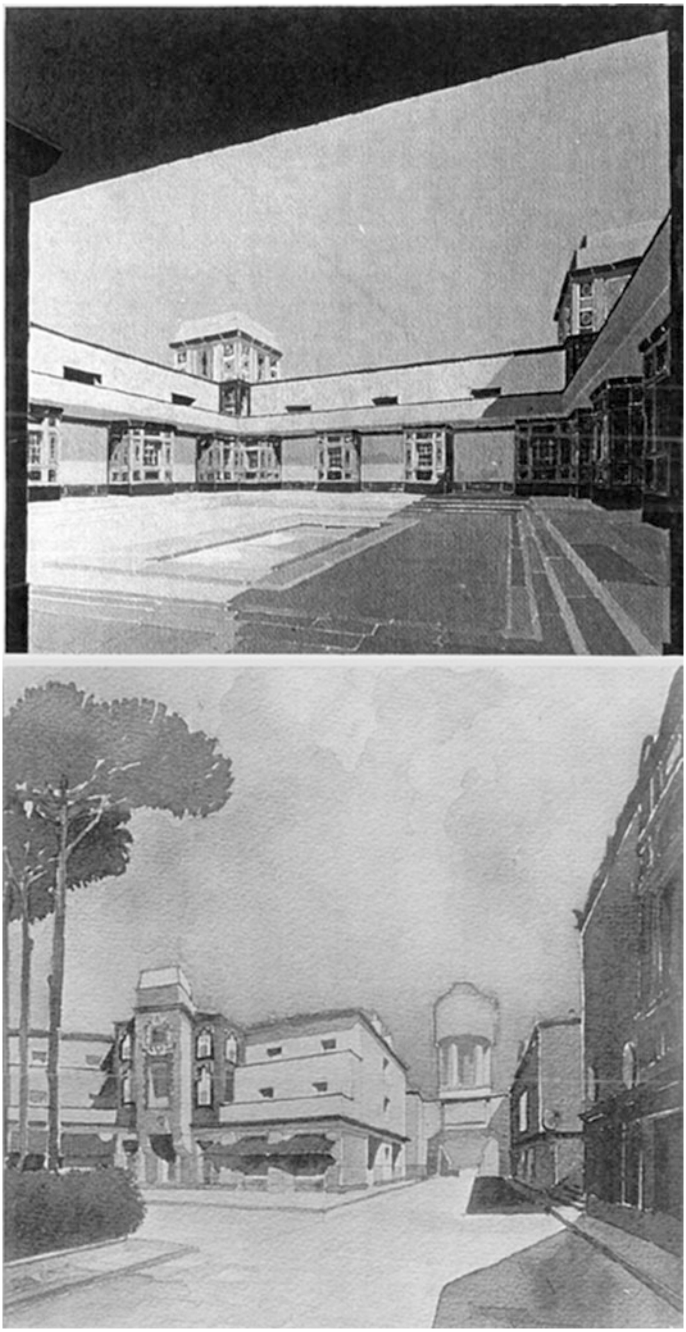


Fig. 5 Gruppo Aschieri, Rome 1926. Views of the buildings earmarked for ceramists (*above*) and tapestry makers (*below*)

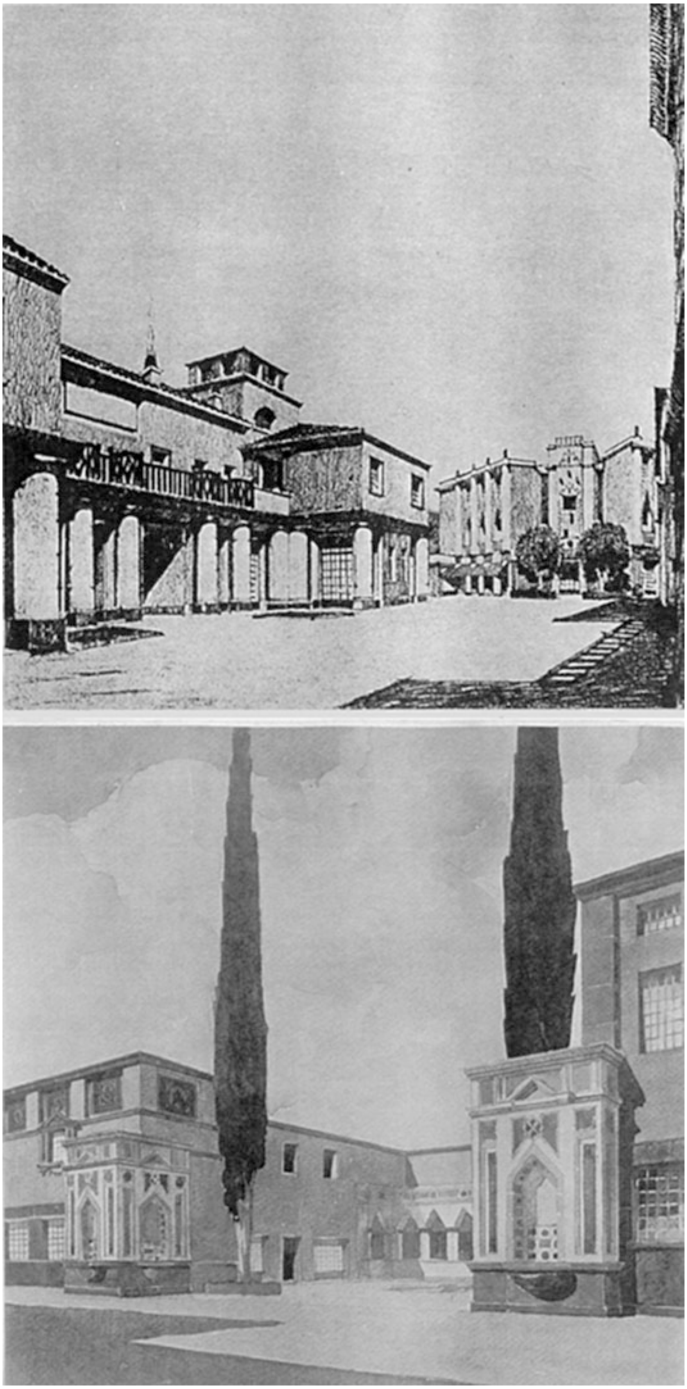


Fig. 6 Gruppo Aschieri, Rome 1926. Views of the buildings earmarked for lace-makers (*above*) and marble workers (*below*)

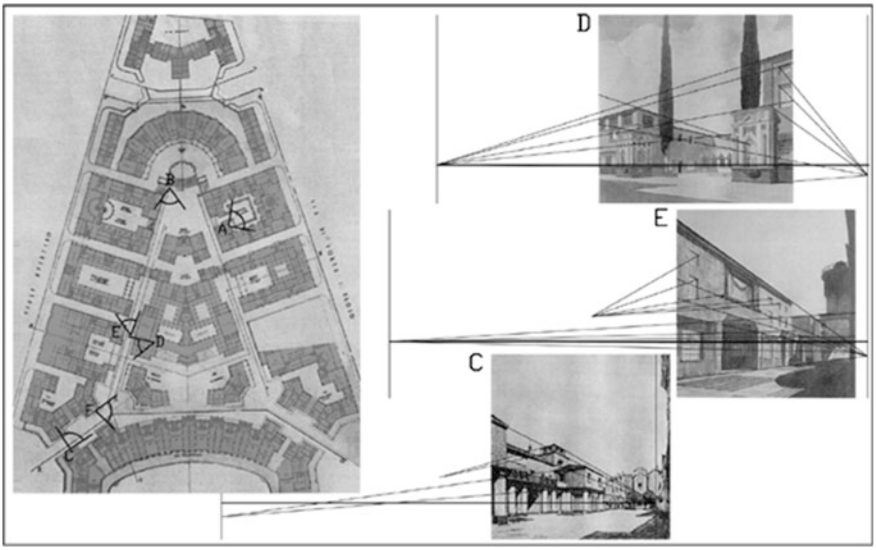


Fig. 7 Gruppo Aschieri, Rome 1926. Plan showing the position of the viewpoints of the perspective views; geometric analysis of the views D.E.C

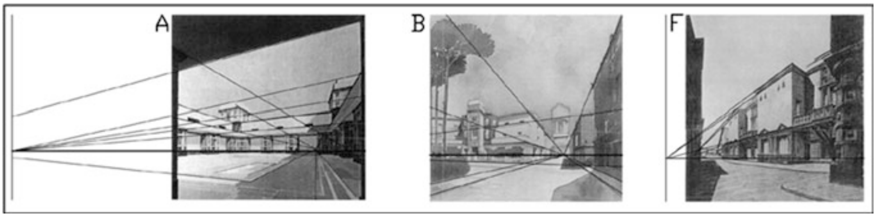
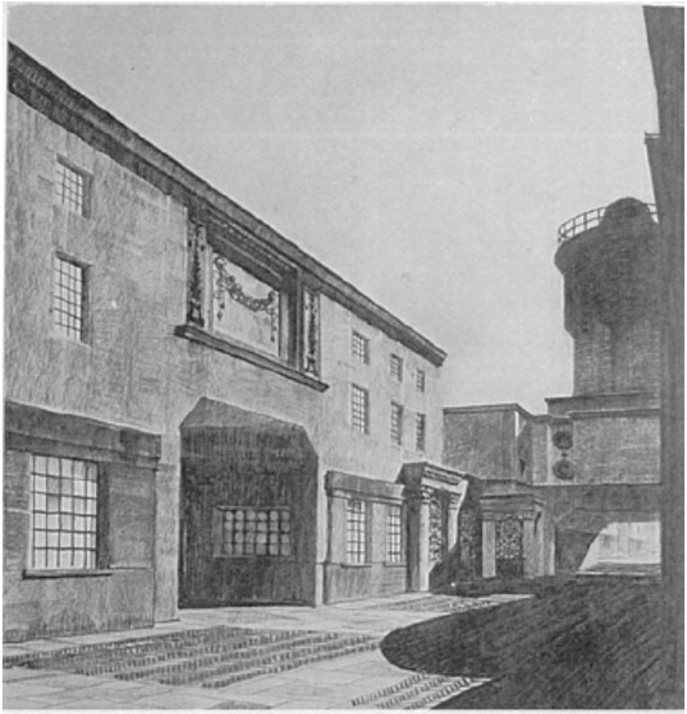


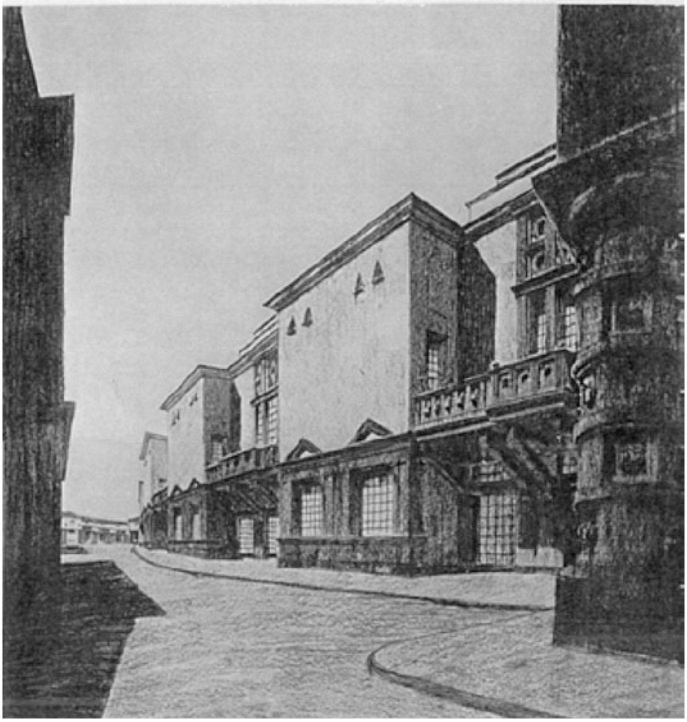
Fig. 8 Gruppo Aschieri, Rome 1926. Geometric analysis of perspective views A, B, F

One example of the former is the formal inconsistency between the façades in Fig. 6 (bottom) and Fig. 9 (top), both relating to the goldsmiths' building. A plausible explanation could either be lack of coordination between the persons involved, or the drawings could have been done at different moments in time.

Another example is the difference in height of the buildings at the bottom of Fig. 6 and the buildings facing each other in section GM in Fig. 2 where instead they are all the same height. One last consideration about the same view in Fig. 6: skilfully portrayed as very tall, the cypresses trees fulfil a dual role as an "architectural" reference in the designed space and as a counterweight to the communicative emphasis of the graphic space.

Fig. 9 Gruppo Aschieri, Rome 1926. Perspective views of the buildings for the goldsmiths ► (*above*) and cabinet makers (*below*)





As mentioned earlier, in many cases the ambiguity depends on the fact competitions had to be completed very quickly. One formal difference is present between the background represented at the bottom of Fig. 9 and the plan of the buildings for the cabinet makers. This could also be due to the fact that the drawing was completed before the fi drawings of the plan and section. During this period the preparatory drawings such as sketches and rough drawings portray the architectural representation; however, the latter is only included much later in the conventional orthogonal projections. Aschieri was one of the fi to use this reversed method when creating, designing and representing architecture.

4 Conclusion

We have mentioned Aschieri's work as a stage set designer. On this issue Paolo Marconi writes: "Aschieri manipulated traditional, nineteenth-century academic stage set design used in Italian melodramas; for stage sets, the principle of symmetrical bipartition of the masses around a centre of interest was more than a dogma, it was second nature. As such, it represented more of a return (…) to sixteenth-century scenographies rather than the ones used by the Bibbiena family; this represents a re-use of the perspective views and ensuing enfilades designed by Palladio and Cortona rather than the essentially illusionistic eighteenth-century "corner views". In fact, sixteenth and seventeenth-century scenography focused more on enhancing the axial and pyramidal features of a composition" (Marconi 1977, 8–9).

More than anyone else, Aschieri was the one who, at least in Rome, used his graphic and scenographic skills to represent the link between ancient and modern. Obviously he used the graphics and techniques he was most familiar with, the ones he governed with incomparable craftsmanship. Aschieri's cultural legacy is naturally revealed in the way he imagines architecture and portrays it on paper. His perspectives take on an air of metaphysical reality in which a sort of unavoidable parting from the Palladian dogmas regarding space co-exists with the immediate feeling of change which, I would add, he promoted rather than invented.

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Participative Graphic Representation with Limited Access Database

Juan Saumell Lladó

Abstract Building architectural heritage has been graphically represented a lot during their lifetime. There are many useful registers. Architects can integrate many knowledge fields, learning from other academic and professional disciplines. Related with graphic documentation, we have gathered, unified or updated many built heritage, by means of academic and researching works. The risk of loss or destruction is very high. Besides collecting graphic sources, written ones are difficult to be classified. Many times the source is complex to combine with the precise building described in the text, physically placed. The information shown in this proposal can be regularly updated.

Keywords Graphic representation · Participation

1 Introduction

The attraction towards the constructed architectural heritage is continuously growing in all cultures. The reactions produced facing its destruction, either those being provoked voluntarily or those affected by natural catastrophes, run throughout the world in a short period of time. The direct demolishing actions are frequently orientated to attribute subjective meanings to the patrimonial element, not noticing the objective beauty or the formal attraction of the constructions, just like its artistic value. We have multiple records of great quantity of inherited elements, in diverse supports, from the hand drawing to the point cloud, through the photography, as a graphic vehicle of wide and fast diffusion, thanks to the generalisation of the use of Information and Communications Technology (ICT). The quality of the results is presented in a very varied manner, including products of notable benefits. The open access to determined digital records allows you to get the idea, by contrast, of material protected by different procedures, from access rights to the files controlled

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by editorials, to records of intellectual property. In reference to the built heritage, a large part of the graphic documentation available refers to the exterior of the buildings, of public nature and within reach of an average citizen. The generalisation of the photographic and filmographic record allows the multiplication and the combination of the data gathering, without excessive effort or specialised technology (Stefani et al. 2013, 1).

Apart from the exterior views of a constructed set of buildings, to know the distribution of interior spaces brings about enormous documental interest in horizontal development as well as vertical. And to this point of view we can refer this work. The interior drawings of a building turn out to be varied as regards to its origin as well as its quality. In parallel, the vast quantity of drawings cover a wide range based on the inherited or professional attraction of the building through its history. As they really are a documentary record, these architectural drawings remain dispersed in public and private files or collected in folders, cabinets or warehouses which have been hardly opened for a long time. The first step towards its public diffusion is to allow it to be known by means of accessible resources, like a Geographic Information System (GIS) which is open and freely accessible.

2 Graphic Support

The supports and the techniques used for the graphic records go from the sketch in field notes or the more or less elaborate painting, to the precise drawing with prior measurement. Photography and cinema with domestic devices within more and more people's reach have brought the architectural heritage closer to the general public throughout the 20th century. The massive distribution of this material via the internet from the nineties allows us to manage graphic records of interest to wide sectors of society.

The professional architectural specific interest for quality products pays attention to the image in its attractive aspect as added value, but with a prior level of precision and objective correspondence with the reality for its assessment on the market. We refer on one part, to the actual dimensions of the object represented to proportionate scale, which permits a spatial analysis of the building in question.

Also the constructive materials interest us much either the visible ones or the hidden ones. And in addition, we pay our attention to the physical state of the constructive materials and systems, in relation to the appearance of the possible problems. The analysis of those dysfunctions allows us to perform, to halt the destructive action (which heads for ruin) as to try out proposals aimed at preserving the heritage. On a graphic project level it is understood that all the considered proposals and trials are reversible and improvable, allowing substitution and improvement.

As the needs of attention to the architectural heritage are high, our first aim is to establish priorities of performance, profiting from opportunities and joining efforts. We are left with prosperity in the world of architecture, which supposes a notable constructive development and a professional incentive. In those times, the attention for the construction sector focuses on private investments and public aids that can be offered across competition of projects or social housing. However in those moments of growth scarce attention to the quality of the graphic records is frequently shown due to the need for accomplishing temporary periods of time with some diverse objectives.

In other phases of the economic cycles, the activity in new construction building slows down as the demand is halting and the market, stagnating. In these circumstances we are given the opportunity to focus on efforts on objects in the longer term that allows us a better preservation of heritage. It may be so that then the investments are reduced, but the items are numerous for cultural promotion and investigation of which a part could be reserved for the graphic documentation of the heritage.

It is well known that other professionals with limited architectural training, although with an aroused conscience and a sharpen ingenuity for these tasks, have paid constant attention to the architectural heritage built from their particular optics, with great merit on theirs, acting on their behalf or associated with professionals in architecture. It may be sufficient to mention programmers developing computer assisted design (CAD) applications and programs, digital models of the area (DEM, Digital Elevation Models) modelling on buildings (BIM, Building Information Modelling), Geographic Information Systems (GIS, Geographic Information Systems), among others. And collaborating with them and their careers, geographers and topographers bring their knowledge to the conservation of the architectural heritage. Concurrently, the world of archaeology makes the most of its resources available in a way attainable to the architectural world (like SITAR 2015, "Sistema Informativo Territoriale Archeologico di Roma"). In this environment the term "neogeography" is adopted as a social phenomenon and in relation with the physical space, and the geographic volunteered or participatory information (VGI, Volunteered Geographic Information, Goodchild 2007). On this same line, the concept of geospatial analysis is used to identify techniques that allow us to match data in two relative dimensions with terrestrial activity (Goodchild 2015).

The interest to spread information across the web has increased in the recent years. Wikimapia and OpenStreetMap are some samples which offer clues to our work. Other services like Flickr (2015) allow photographs to be uploaded, accurately located. Also Google Earth motivates volunteers to develop applications using its resources. From there the expression "mashup" has been popularized meaning the use of diverse sources of geographical information on a webpage. In the beginning the relationship between user and server was in an only one way, accessing certain information by means of related links. Soon users could access databases on the web, enabling travel reservations and internet shopping. The sophistication continues to grow and users can generate new contents, with limited control on behalf of the server. The Geographic Information Systems (GIS) relate a place to determined latitude and longitude coordinates. The GPS (Global Positioning System) becomes accessible to anyone from a mobile device. The level of specialisation required to collaborate in volunteered geographical information, VGI, depending on the collected data: it is not the same to collect types of soil of a territory that street names that appear on signs. The problem that we find to extend the VGI is the volunteers' lack to work in a specific direction, or the need to control in some way the accuracy of tasks. In any case, the biggest value of VGI is that it offers accurate local information of quality to everyone across web resources. The information is collected by a great variety of participants, organised in a database and distributed in multiple digital formats across the web (Haklay 2010, 682).

In this environment, making the most of the resources available, the architect is able to show the architectural heritage from the understanding of the building (distribution of spaces, materials, constructive systems, pathologies) and its graphic representation. In this way, the area of graphic architectural expression integrates diverse fields of knowledge and learns from other professional and academic specialties.

3 Graphic Sources

The main material to compile, elaborate and to show is found in graphic sources. As added value to the available resources on the internet, from photographs to 3D models, it is suggested spreading the floor plans of the buildings, showing its interior distribution. In this sense, what you do not see from the exterior is spread. We focus on the ground floor, the usual level of access from the street, with a double objective. On one side, the ground floor shows the relationship between the interior spaces of the building, enabling its functional comprehension (Ulrich 2003, 6). On the other part, the information offered is limited in the first instance in order to be more agile, simplifying the exposed data. With the offered references, you can access the graphic supplementary documentation of the floors, sections, elevations and details.

The graphic sources come from either the professional or the academic area. We can count within the professional field on public entities as Minister of Culture of the Government of Spain and the regional Government of Extremadura, the provincial council of Caceres or the municipal council of Caceres. From this last one, the recent archives as well as the records of the works digitalised and shown on the Caceres town hall web ("Caceres Histórica" 2015, following the route: "SIG de Cáceres 2015/Cáceres Histórica/Archivo Histórico/Expedientes de obras") have been checked. Likewise the contribution from particular professionals (architects and technical architects with rehabilitation and reform projects and premises' adaptations) is valued. A desirable source of documentation which is in its study phase are the archives of professional association in Architecture and Technical Architecture; an opportune caution to save the intellectual property of the deposited works has been established. A guide that has led this work from the beginning has been to cite the used source and elaborate the materials graphically to bring the exhibition together.

The academic resources were the reason and the origin of this dissemination programme (Saumell 2014). There are works and elaborated projects by pupils placed in university libraries. In the central library of Caceres of the University of Extremadura the funds of the Building and Technical Architecture studies are guarded, organised in each database, carried out by Prieto (2000) and Mato Antolín (2013). On bringing these plans to light, their disappearance is avoided, before risk of loss or ruin by transfer or inadequate conservation by insufficiency of the means (Alonso Rodríguez et al. 2014, 52). Besides other unpublished investigations could be quoted like those of Serafin Martin Nieto, of the History Academy on the church of Santiago of Caceres as an example (partly in Martin 1998). In the first phase, to limit the action to an area marked out by the Special Plan of Protection and Revitalization of the Architectural Heritage of Caceres of 1990 was decided, which includes the area within the walls and the surrounding areas affecting 1800 properties, gathering information in the GIS from the local government of Caceres (SIG de Caceres 2015) (Fig. 1).

Apart from the graphic material, the written sources mean an important complement. The aforementioned writing is available in different databases, with free and conditioned access. The contribution carried out in this work implies linking the investigation work published with a given place. With that, duplications in the name of the buildings are overcome; linking them to a physical space in the territory, with precise space coordinates (Stefani et al. 2013, 13:2). Other works are integrated in monographs, whose search turns out to be laborious as they are paragraphs and relative at a place paragraphs, without getting to form a complete chapter or spread over different sections, although they contribute important progress in the investigation like the thesis of Maria Jesus Teixido in Art History,

Fig. 1 View of the inner wall area of the city of Caceres on the GIS

called: Conservation, interventions and restored practice in the historic centre of Caceres (1850–1975), (Teixido 2014).

Once the sources of the documentation are outlined, we continue to define the organization of the database for its appropriate dissemination. We accept that the heart of the work consists of a graphic base, with a written bibliographical complement.

4 Methodology

Two levels of definition are established: the graphic organisation in layers and the literary exhibition in a simple table. For the establishment of the layers and the graphic language, we have been looking for the maximum simplification, dealing with the available material as to the clarity of the exhibition. The level of definition has been adopted for a scale of visualisation and impression between 1:200 and 1:500, in such a way that the separation between the drawn lines is higher than half a millimetre, getting nearer to the valid drawing regulation (AENOR 2002). The graphic support is what GIS offers us from the local government of Caceres with the corresponding projection plan of 2012, rectified on-site in 2013. That plan counts on the projection of the covers, and the alignment of facades at street level, as well as the curves and topographic levels on the ground. The first step is the design of the horizontal floor, usually the main access point from the street level, and then we have an available reference quote from the topographical plan in which the floor is inserted. This level of definition allows us to notice steps and stairs and partitions of up to 10 centimetres, with the distribution of the interior spaces. Three main layers are established and three more, complementary. On one part, the section or cut of the walls, the projection seen from the stairs (which the connection of the floor shown with other levels can be observed) and the hidden projection or over the ceiling (vaults and coffered ceilings) over the ground. On the other side other direct projections appear which indicates inclines in the floor, the organisation of free internal spaces (courtyards) and the padding in the walls for better visibility. With these six layers we count on basic information of the internal space organisation of the buildings (Fig. 2).

In relation to the written data we offer complementary information of the buildings marking a signal situated on each one of the buildings. A table supplies a catalogue number, the address, the source of the information used for graphic support, and the bibliographical references, just in case. Dealing with such a collaborative work, its updating is possible, either in the graphic sources or in the bibliographic references of inherited interest (Fig. 3).

5 Digital Dissemination

The information mentioned is presented in a viewfinder of a geographic information system accessible to the public (Architectural heritage viewfinder of the GIS of Caceres 2015). In this way the novelty of the support is fulfilled with exactness of

Fig. 2 Detail of the inner wall area of the city of Caceres on the GIS

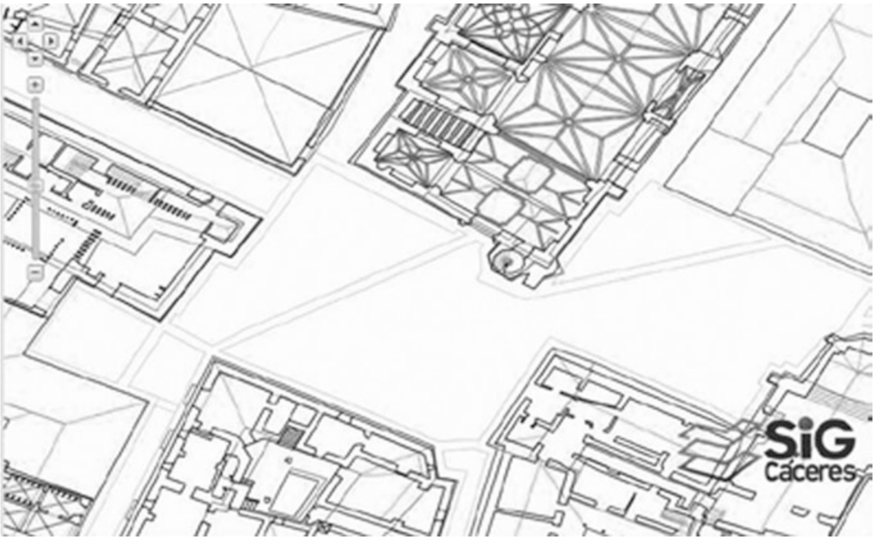

Fig. 3 San Mateo Square on the GIS of Cáceres

the accuracy (Larumbe 2014, 827). This viewfinder is continually being updated and it is possible to notice variations depending on the moment in which it is used. Activating the "Trama Urbana 2012" layer in that application corresponding to the more recent projection, as well as the Lines of the floor (*Líneas de planta*) and the

Identifiers (*Identificadores*) on the typological plan of the ground floors, we access the shown documentation organised in layers. The first layer we notice is titled "Bovedas" (Vaults) and represents the projection of the ribs and intersections of the uncovered interior areas, as well as the coffered ceilings. Some buildings are missing information on this layer, as they have either flat ceilings or there is no representing level in the sources used for its transcription and exhibition. The next layer, Stairs (*Escaleras*), lets you see at least the existence of an upper floor, as well as the situation and relevance of the stairs in the layout. The layer "Muros" (walls) represents the horizontal section, defining the organisation of the inner spaces and the separation with the exterior. If desired, this layer could be projected, activating the "Relleno de planta" (padding of the level). A layer called "Muros finos" (thin walls) represents the projection of the unsectioned level changes on the floor. Finally, on the layer "Patio" (courtyard) the open spaces are highlighted, usually uncovered, in the interior of the buildings (Figs. 4 and 5).

You can access the literary and bibliographic information activating an information icon (a white "i" on a green background) situated on a floor of the building. A window with specific data of the building is opened (Fig. 6).

As complementary documentation, the elevations of the buildings included in the limitations of the Special Protection Plan, are inserted in the application, prepared by academic works of Trejo (2014), Rodriguez (2014) and Garcia (2014). To visualize them, the heading "Alzado" (elevation) from the folder "Alzados de calles" (street elevations) is activated and, clicking on the green line which runs up the axis of the corresponding street of the building, an information box is opened which allows a PDF file with the elevation to be seen (Figs. 7, 8, 9 and 10).

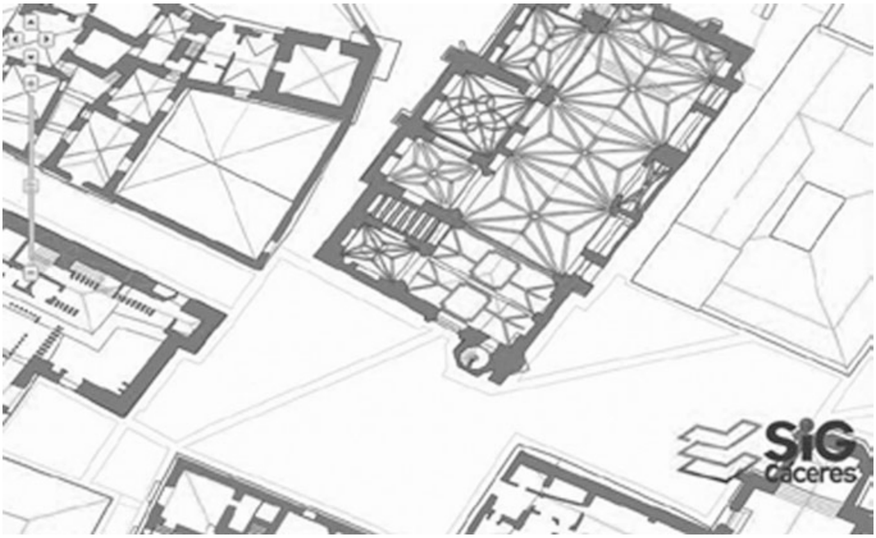

Fig. 4 San Mateo Square on the GIS of Cáceres with "Relleno de planta" layer activated

Fig. 5 The inner wall area of the city of Caceres with ID activated

Fig. 6 Information of the building

6 Updating

Graphic and bibliographic information is connected to a physical place through a geographic information system, under digital support visible on an open and free webpage. The information is linked to an unambiguous physical point allowing useful documentation to be accessed for the investigation and open to being continuously enriched. The used platform, the GIS of the local government of Caceres

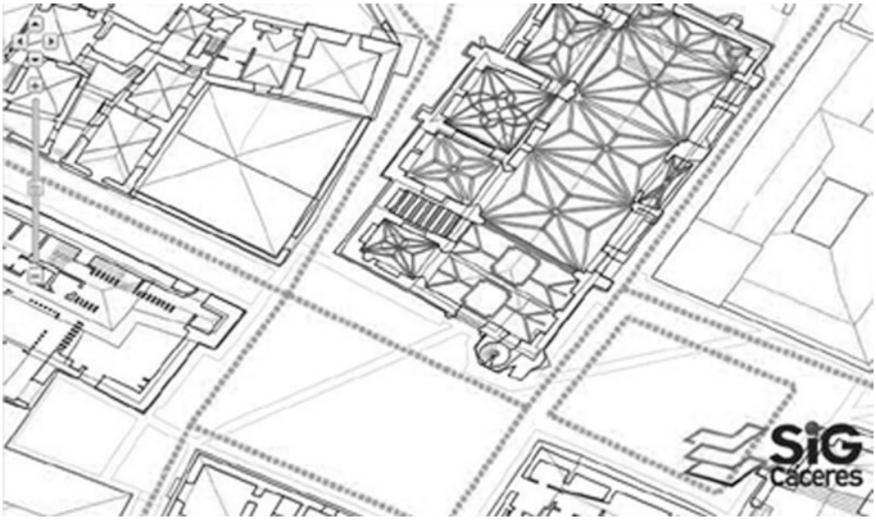

Fig. 7 The inner wall area of the city of Caceres with "Alzados" activated

Fig. 8 Information of the elevation

means a first step for its extension to the Extremadura Space Data Infrastructure (IDEE in Spanish language) and to other more disseminated and significant applications like Google Earth, Bing Maps or similar. This experience initiated in the city of Caceres is transferable to other towns. In the first stage other historical cities in Extremadura can be included, to complete the territory in a collaborating work.

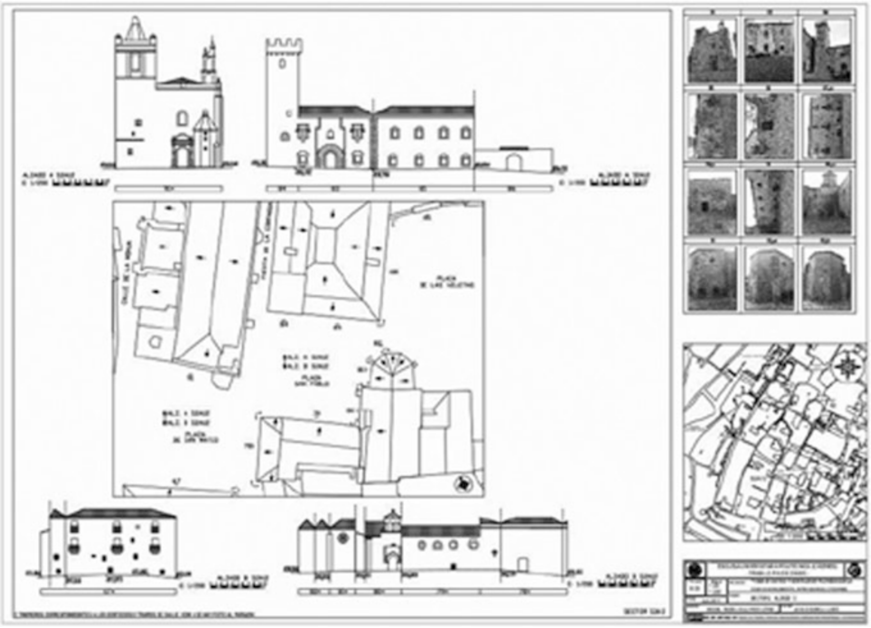

Fig. 9 Elevation of the building in PDF format

Fig. 10 Elevation detail

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Baukunst. Goethe's Notes for a Treatise on Architecture

Juan Calduch Cervera and Alberto Rubio Garrido

Abstract In Italy, Goethe's interest in architecture increased. Back, with reference to Winckelmann, he started a small treatise on architecture. Dated 1795, it's entitled *Baukunst*. It is a folder of 13 numbered pages, with some blank sheets and barely hinted pencil drawings that show its unfinished nature. Text on each page occupies the middle right of a folio and leaves the left side free to place corresponding drawings. The comparison between both text and drawings can give us a more complete view of Goethe's architectural theory as counterpoint to his criticism and analytical or descriptive comments of buildings.

Keywords Goethe · Treaty · Architecture

Goethe's "cultivated dabbler"[1] interest in architecture opted for the Palladian classicism after his journey to Italy (1786–1788), beating his youthful enthusiasm for the Gothic. Although he already hinted his limitations for the practice of the visual arts in the published text,[2] the truth is that he could internalize this deficiency when preparing its edition thirty years later. However, during his stay in Italy and

[1]Goethe differentiates between *vulgar dabbler*, *cultivated or authentic dabbler* and *professional artist*. If the *vulgar dabbler* only requires to the work of art to "look natural", *authentic dabbler* [wahre Liebhaber] seeks "truth of imitation" and "excellence of selection and ingenious of composition" (Goethe 1999, 126). To discover rules and laws of art printed by the artist in his work raises "the so-called dabbler […] to the spirit of the artist" (Goethe 1999, 47).
[2]*Italienische Reise. Auch ich in Arkadien!* [*Italian Journey. I, too, in Arcadia!*]. First edition, 1816/1817; final edition, 1829.

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beyond, he showed great interest in the study of architecture, surpassing a mere dilettante curiosity.[3]

1 Foundations of Goethe's Architectural Thought

His architectural ideas, matured during those years, were collected in *Baukunst* writing, which was left unfinished in 1795. This text, whose structure resembles that of a small treatise where both drawings and texts are combined and reinforced each other, reflects influences of his architectural education. Along with the visit, study and enjoyment of Ancient and Renaissance works during his journey, three parallel tracks outlined his background in these matters, and were finally reflected in the text: first, practice of architectural drawing; second, knowledge of theoretical foundations of architecture by studying texts, written and treatises; finally, exchange of ideas with architects, studious, archaeologists, academics and other professionals.

Goethe first task was to master architectural drawing with the practice of perspective and the knowledge of specific graphic systems. In Rome he attended some classes of perspective given by the architect Maximilian von Vershaffelt (Goethe 1991, III: 1294). There are some exercises from that time (Femmel [1958] 1972, III: 110; III: 111; III: 112; III: 113; III: 115; III: 116; III: 117; III: 118) and others dated during the years when he worked on *Baukunst* (Femmel [1958] 1972, IVb: 133; Va: 114). In some cases it is clear which models Goethe was using (Figs. 1 and 2).

Architectural drawings are generally freehand made, using the dihedral system (plans, elevations, sections and details) and then adjusted to exclusively technical images. There are drawings of this type made in Italy and years later representing bases, chapiters, columns, cornices, moldings and other elements, often copied from Palladio's, Scamozzi's, Serlio's, Galiani's, etc. treatises (Femmel [1958] 1972, II: 177 rs.; III: 66; III: 93; III: 94; III: 104; III: 105; IVb: 106; IVb: 112; IVb: 118; IVb: 204; VIa: 158 rs.). He made drawings of landscapes and views with architectural and ruins issues too (Femmel [1958] 1972, IVa: 2; IVa: 8; IVa: 9; IVa: 139; IVa: 140; IVb: 187), following, in this case, the tradition of *vedutisti* as Piranesi (Goethe 1991, III: 1342), Clérisseau (Goethe 1991, III: 1149) or Van der Neer (Goethe 1991, III: 1266) among others. However, there are no similar artistic drawings on *Baukunst*, showing that this text had for him an unquestionable theoretical nature (Fig. 3).

During those years, Goethe studied classic treatises. At the beginning of his journey, he bought in Padua an edition of Palladio's treatise (Goethe 1991, III: 1074) and, in Venice, bilingual text Latin/Italian of Galiani's *Vitruvio* (Goethe

[3]Unlike *amateur*, who enjoys watching art, dilettante exercised it but not professionally as the artist does. There cannot be a dilettante architect attending the complexity of building. At best there may be, if anything, a dilettante designer. Goethe criticized dilettantism (Goethe 1991, I: 442), but he was also sympathetic with (Arnaldo 2012, 23; Goethe 1991, III: 1152).

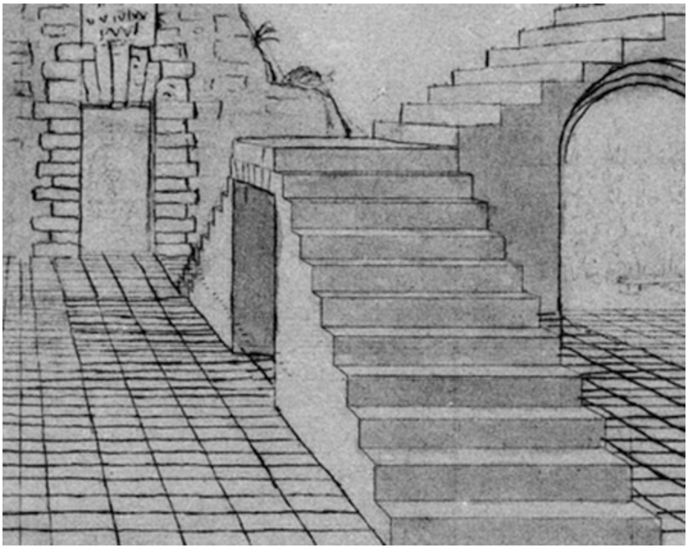

Fig. 1 Johann W. Goethe, *Treppenanlage*, 1787/1788 (Femmel [1958] 1972, III: 118)

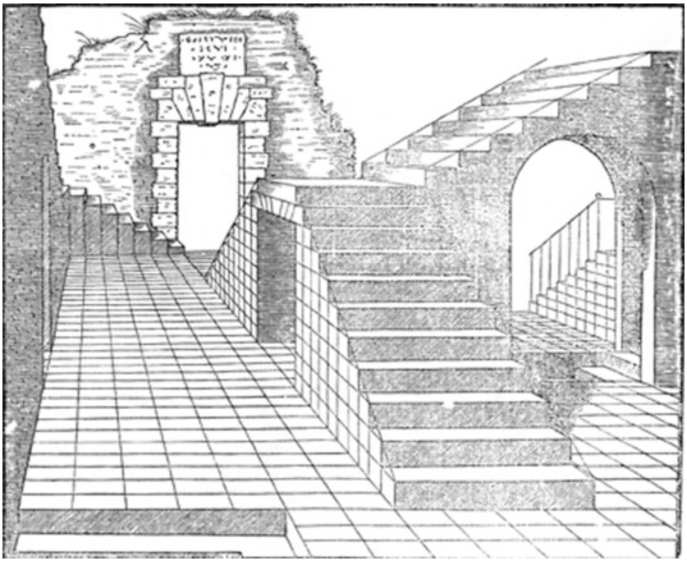

Fig. 2 Serlio (1537–1551, II: 19 obv.)

1991, III: 1100). Bombastic and academic sheets of this treatise exude a Palladian tone, assumed by his author. In Vicenza he visited "the elderly architect [Ottavio Bertotti] Scamozzi, who has edited Palladio's buildings" (Goethe 1991, III: 1071).

In the storytelling of the journey, he quoted him with admiration up to twenty times. He even interpreted Vitruvio through him. He wrote: “with his words and works, his way of thinking and creating, Palladio has brought me more the *Vitruvius* and helped me with better than its Italian translation” (Goethe 1991, III: 1100). In short, Goethe’s learning through main treatises was heavily imbued with Palladianism. In *Baukunst* he used examples of Palladio, and, like him, he never employed perspective in its drawings.

But in the late eighteenth century, architectural theory of Renaissance treatises, which unified theory and practice, had exhausted its cycle. There was a split between different disciplines, which gave form to a plural and dispersed architectural thought in different areas such as history, archaeology and theoretical or philosophical essays. It opened the way to modern architectural thinking. Specialists in these fields

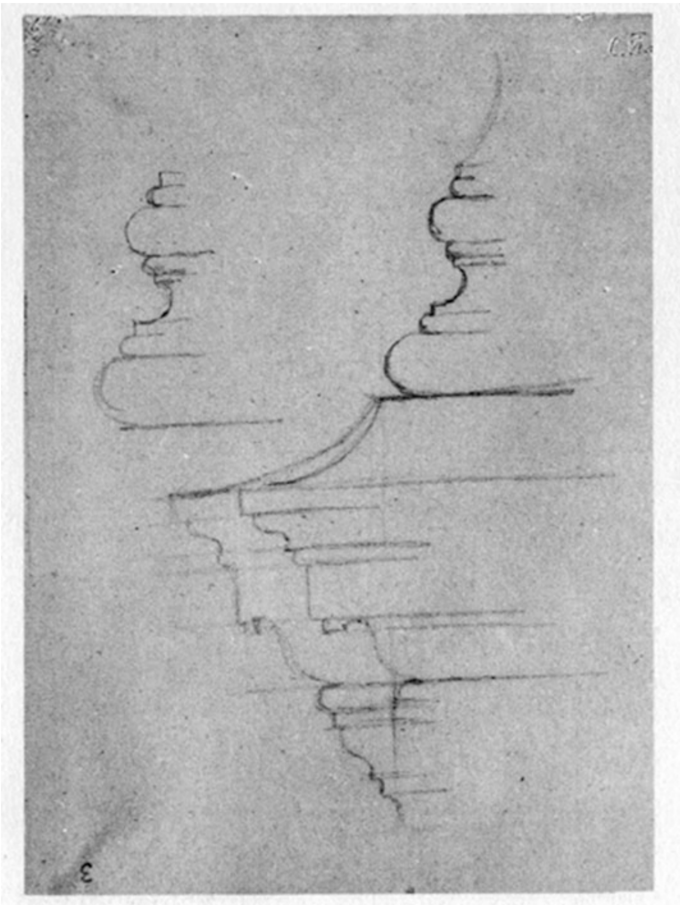

Fig. 3 Johann W. Goethe, *Piedestalund Säulenbasisprofile*, 1795/1797 (Femmel [1958] 1972, VIa: 158 rs.)

influenced Goethe's architectural taste, such as: the theologian, philosopher and critic Herder, who had excited the young Goethe for Gothic and from who he distanced himself, however, years later (Goethe 1991, III: 1253); the archaeologist Hirt (Goethe 1991, III: 1335); engravers, antiquarian, art theorists and artists as Lafreri, Lomazzo and Bellori (Goethe 1991, III: 1332); the historian Meyer (Goethe 1991, III: 1338); thinkers and philosophers like Kant (Eckermann 2005, 339) or Lessing (Eckermann 2005, 393) but, above all, Winckelmann (Goethe 1991, III: 1148), whose ideas were essential to its interpretation of classicism and his enthusiasm for Greek architecture. Especially his book *Remarks on the Architecture of the Ancients* [1762] was reflected in Goethe's *Baukunst*.

The complement to the study of treatises was the relationship with architects, artists and thinkers (Goethe 1991, III: 1139). He met in Rome the architect Arens. He then called him to work in Weimar when he was writing the first drafts of *Baukunst*.[4] Cassas' sheets awaked his interest in antiquities from Palmira and Egypt (Goethe 1991, III: 1308). He related to studious such as Moritz (Goethe 1991, III: 1308)[5] and painters and artists such as Hackert (Goethe 1991, III: 1175), Kniep (Goethe 1991, III: 1183) and Tischbein (Goethe 1991, III: 1128 and 1154) who accompanied him on his journey, during which he drew and make surveys of ruins and buildings. These relationships placed Goethe in the field of artistic practice and theoretical debates. However for the experience of building and construction it was important official positions he held at the court of Weimar,[6] which faced him directly with the technical, economic and management problems.

We find then Goethe divided into two parallel interests. On the one hand, theoretical reflections on fine arts and architecture; and, on the other, everyday issues of construction and civil engineering. Founded in this practical experience, he underlined in *Baukunst* differences between construction as technic and architecture as art. A professional architect like Palladio had never posed this dissociation; for him, theory made sense only as a support and justification for practice. This different approach with respect to professional architect is perhaps a telling sign of Goethe's stance regarding architecture.

This text about the "art of building" (literal translation) deals with two questions, which had focused his interest and scientific research; the quest for original plant [Urpflanze] (Goethe 1991, III: 1215), root of all flora, and the thesis of morphology,

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[4]The writing of *Baukunst* was delayed over several months. There is documentary evidence of two previous drafts: the first one dated in 10.29.1795 and the second one in 05.11.1795. Goethe worked on *Baukunst* at least until 25/01/1796, when he tells Meyer he renounces to finish it (Goethe 2004, 10: 5442). In addition, a previous essay entitled "Baukunst" was published in *Der Teutsche Merkur* in October 1788.

[5]Goethe included in his book part of Moritz' text *On the plastic imitation of the beautiful* [Über die bildende Nachahmung des Schönen, 1788] (Goethe 1991, III: 1395–1400).

[6]According to Cansinos, the Duke appointed Goethe in 1776 Director of Court Theatre; in 1777, President of the Commission for Architecture for the Reconstruction of the Palace (after the fire of 05.06.1774); in 1779, Director of Departments of War and for Civil Engineering; and in 1782, Director of the Treasury (Goethe 1991, I: 93).

understood as formation and modification of plants by metamorphosis.[7] Goethe believed that there should be an original type followed by all subsequent variants through metamorphosis.

Baukunst transfers these ideas to architecture. According to Goethe, *old Doric* [Altes] order, which emerged from primitive wooden buildings[8] and referred directly to nature, should be the undisputed origin of architecture, creating, through metamorphosis, all other orders.

In short, different interests emerge in Goethe's *Baukunst*. The document assumes implicitly the model of Renaissance treatises but, unlike them, it is not geared to professional practice in order to provide models and design solutions, but seeks a rational explanation of the origin of architecture and the transformation of orders.

2 Baukunst

The document is a folder with thirteen pages, written and drawn, where applicable, on both sides. Text on each page occupies the middle right of a folio and leaves the left side free to place corresponding drawings. There are uncompleted columns of text, some blank sheets and barely hinted pencil drawings that show its unfinished nature, but with an extension, structure and planned work.[9]

There are a total of seventeen drawings adjusted to the graphic conventions of dihedral system. The essay consists in two parts.[10] In the first part, Goethe deduces a theory of architecture with a conceptual deployment that, in the second part, is illustrated with various examples of architectural history accompanied by drawings. The text of the first part seems completed but the one of the second part was drawn up in fragments. In both cases, there are reserve spaces for possible drawings, although just in the second part, given written references, it seems likely that there are some missing drawings.

Following aesthetic of taste, Goethe assumes that every theory has to "determine in each art what is worthy of praise or blame" by way of "a rule of our judgments." Against classical treatises, which want to establish an objective corpus of architectural knowledge, Goethe postulates judgment criteria of art following paradigms

[7]In 1790, Goethe published *The Metamorphosis of Plants* [*Versuch die Metamorphose der Pflanzen zu erklären*], where he exposed these ideas (Goethe 1991, I).

[8]This theory was in those times very general and Goethe took it from Hirt (Goethe 1991, III: 1335), Winckelmann (1985) and Galiani.

[9]Quotations from *Baukunst* proceed from an unpublished translation by Alberto Rubio Garrido coming from Goethe und Schiller-Archiv's original (GSA 25/XLV, 6).

[10]The text is divided into several sections or chapters, although only first two are developed: "*Baukunst*" (from folio 2 obverse to folio 7 obverse) and "*Basen ganzer Gebäude*" (from folio 8 to 10 obverse, where text is interrupted and pencil drawings are unfinished). In folio 12 obverse there is an index of sections and subsections referring to chapiters, shafts and bases, according to orders (Doric, Ionic and Corinthian) and differentiating between old and new.

of aesthetics of reception.[11] Although he says that many of his observations in *Baukunst* should be extrapolated to every art, he focused his discussion on specific conditions of architecture. This specificity of architecture lies in the imposition of prior material[12] and its inevitable guidance to a purpose. Both questions influence architectural form. Architectural aim is threefold: the immediate purpose (the need or what is useful), the high purpose (sensuous harmony) and the highest purpose (poetic fiction).[13] This theoretical formulation binds and is coherently explained with examples he provides subsequently.

"Immediate" purpose [der nächste] attends the necessary as required by material, or useful when technology allows different alternatives solutions. Etruscan works exemplify this immediate purpose and, strictly speaking, they are no art for Goethe. He illustrates them referring to the evolution of wall from cyclopean (*opus incertum*) to the one coupled with regular blocks (from *opus pseudisodomum* to *opus isodomum*) (Fig. 4).

Only to become art architecture has to incorporate to functionality the "sensible harmony". From original form, which satisfies an immediate purpose, taking beauty as an endpoint it gives a central role to the doctrine of proportion. Synthesis between need and beauty lends character to the building and illuminates the idea of architectural type. But now, since character is not measurable, it cannot be reduced to specific numerical relationships, although laws of proportion are involved. Hence the idea of architectural type, foundation of character, does not correspond with matching proportions between different specific buildings. In short, immediate purpose refers to utility, while high purpose [der höhere] is the aesthetic symbol of functional necessity surpassing material requirements of architecture. Thus, the artist moves forward in the domination of material.

For Goethe an example of this progression is the evolution of crepidoma from Greek temples, which is developed in the second part of *Baukunst* with the title "Bases of buildings in full." Functionality of access to the interior of the temple led to the development of continuous steps around its perimeter. But to give them proportions according to overall dimensions of the building, and looking for beauty, they acquired an impracticable height, forcing therefore to add intermediate steps in main front[14] (Fig. 5).

[11]Aesthetics of reception, different from aesthetics of production, converges with aforementioned Moritz's text.

[12]For Goethe, "material" refers to physical-mechanical conditions of raw materials: strength, durability, mechanical behaviour of wood, of stone … They have a negative character because of its resistance to take on new architectural forms if is not through "technical knowledge and insight" (Goethe 1795, 4).

[13]This recalls the Vitruvian triad: where *firmitas* corresponds to an immediate purpose of architecture, *utilitas* to the high purpose and *venustas* to the highest purpose, as Cage (1980, 199), Salmeron in Goethe (1999, 77), Bisky (2000, 72) and Forssman (2000, 7–25) had point out. Despite this similarity, Goethe departed from that tradition and reached the orbit of the *harmony of the senses* [sinnlichen Harmonie] (Einem 1972, 103).

[14]Winckelmann (1985) provided the same example.

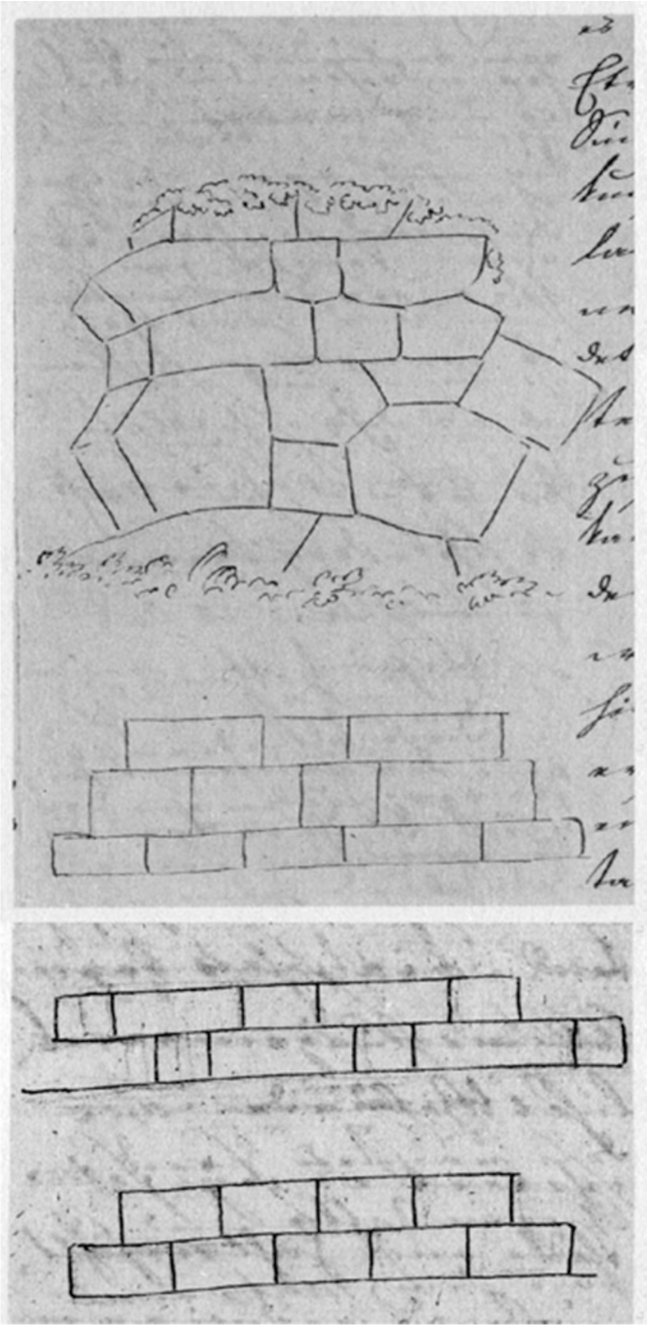

Fig. 4 Johann W. Goethe, *Antiker Steinverband*, 1795 (Femmel 1958 1972, VIa: 153 rs. y 153)

This shows that harmony in the proportions of a building is linked to its functionality rather than to added ornaments. According to Goethe, this example anticipates Roman podium *in antis* enhancing frontal access and removing side ones. Functional drift leads then to a new type, which, in turn, led to other problems solved with new solutions as a "fully independent columns on pedestals" (Goethe 1795, 17).

Following his progressive approach, if beauty is derived from functionality, from high purpose emerges highest purpose [der höchste] through morphological intermediate steps. In this sense, for Goethe Temple of Minerva in Assisi, studied during his journey to Italy, is only a transitional example in appearance[15] (Fig. 6).

Out of necessity (because there is little space for its development), staircase penetrates beyond the line of columns. The effect is similar to columns on pedestals, when in fact they "are on the floor of the portico, which is only broken by the ladder" (Goethe 1795, 17).[16] There are also cases of isolated pedestals without stairs, i.e., not under purpose, unlike in Assisi. Goethe illustrated this with two examples from Palladian treatise: on one drawing resembling the Temple of Clitumno, "bases [are] clearly divided" (Goethe 1795, 17) (Figs. 7 and 8).

In the metamorphosis of base, an attempt to establish a kind of independent pedestal with divided bases beginning from continuous socle constitutes the starting point for progression to highest purpose. After the evolution in classical times, Palladio diversified solutions, enhancing the character of buildings and reaching its most evolved form. Although most of Palladio's buildings barely exceeded design of pedestals as projections of bases (similar to first figure in drawing below), Goethe gives an example of separate base "as ideal extending of base" (Goethe 1795, 18) (Fig. 9).

Not surprisingly, this second image is a villa—Villa Thiene (Palladio 1570, 2: 64)?—, where "he had more freedom" compared to his urban buildings. This nuance is crucial to the assessment of highest purpose. Architect ignores requirements of necessity and thus raises himself to a status of freedom that can illuminate the "poetic fiction" in architecture this art, last aspiration.[17] "At this point no one has surpassed Palladio, he has moved in this profession freely," says Goethe (1795, 12). If craftsman meets immediate purpose of usefulness and it is need an artist to make a building a work of art for the senses, a genius is required to reach poetic values. But some limits also arise, as we have seen and as Goethe illustrated (or so we can venture) in the following graphic examples, which he left without explanatory comments (Fig. 10).

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[15]See 25.10.1786 in his *Italian Journey* (Goethe 1991, III: 1113–1114).

[16]This interpretation is correct and moves away from the one drawn by Palladio (1570, IV: 105). Goethe accuses him of "having drawn the temple just hearsay" (Goethe 1795, 17) giving thus rise to "an ugly Palmyrian monster" (Goethe 1991, III: 1114). See Ghisetti (2006-2007, 117).

[17]Goethe is influenced here by Schiller's conception of "freedom in appearance." Schiller was, along with Meyer, a privileged interlocutor in the creation of *Baukunst* (Goethe 2004, 10: 2808 and folowing).

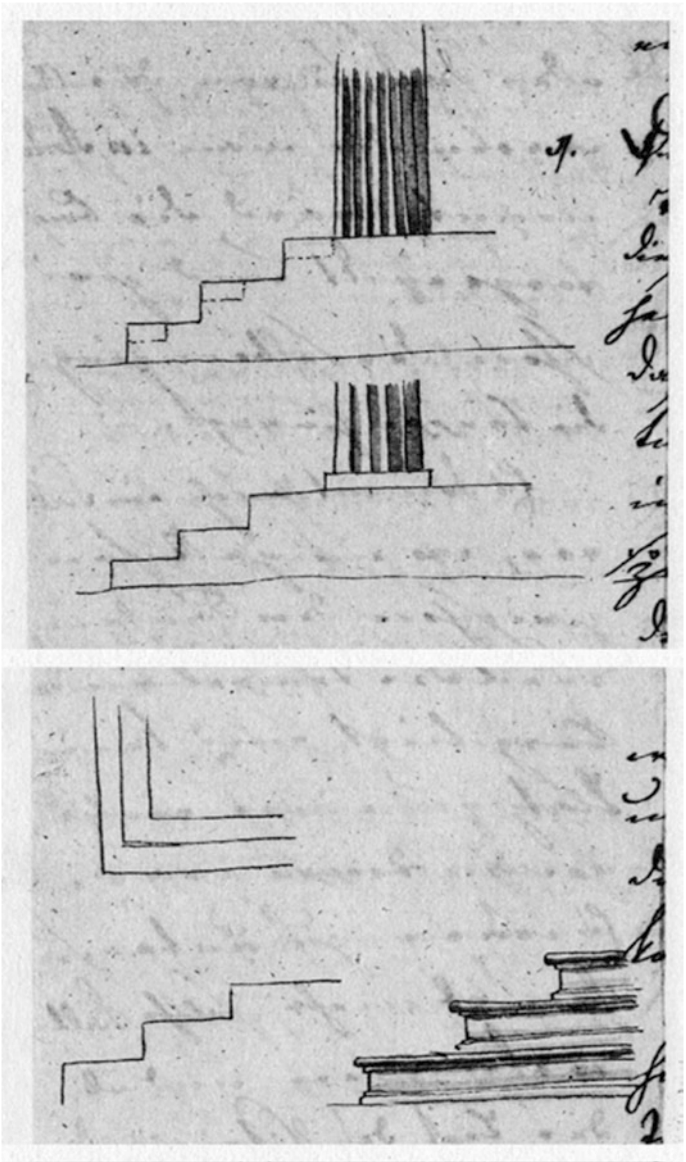

Fig. 5 Johann W. Goethe, *Krepidoma des antiken Tempels*, 1795 (Femmel [1958] 1972, VIa: 154)

They are: a portico of columns with a front staircase, which remind the type *in antis*, a pedestal and a column without base, an elevation façade with front columns on a continuous base (interrupted only by the gateway, which refers again to Palladian models) and a balustrade. They are all examples for Goethe of the

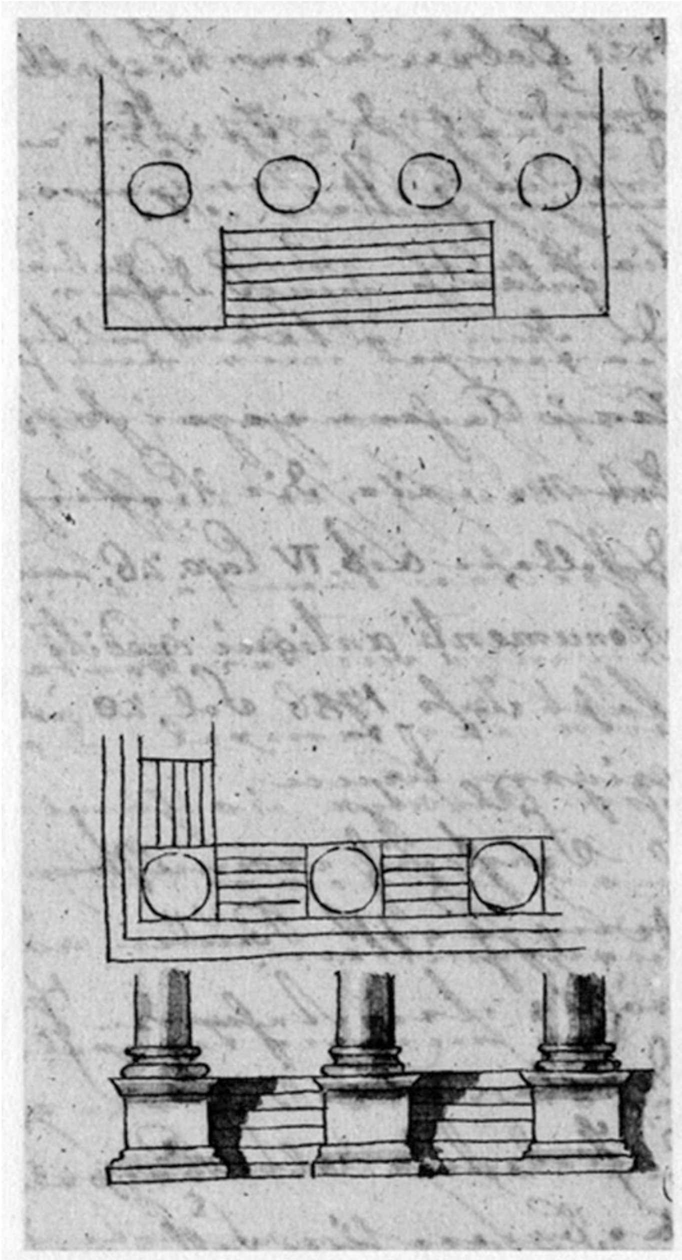

Fig. 6 Johann W. Goethe, *Krepis an der Forntseite des Antentemples*, 1795 (Femmel [1958] 1972, VIa: 154 rs.)

multiplicity of different ways to address the requirement of "poetic fiction". It is, in short, emergence of new forms of architectural language by transferring from one type to another, through imitation. Here, senses are mere intermediaries between object and viewer's intellect. It only may occur an improved aesthetic judgment on a spiritual level reached by a particular education, raising "over satisfaction of sense" thanks to the "poetic fiction" in architecture.

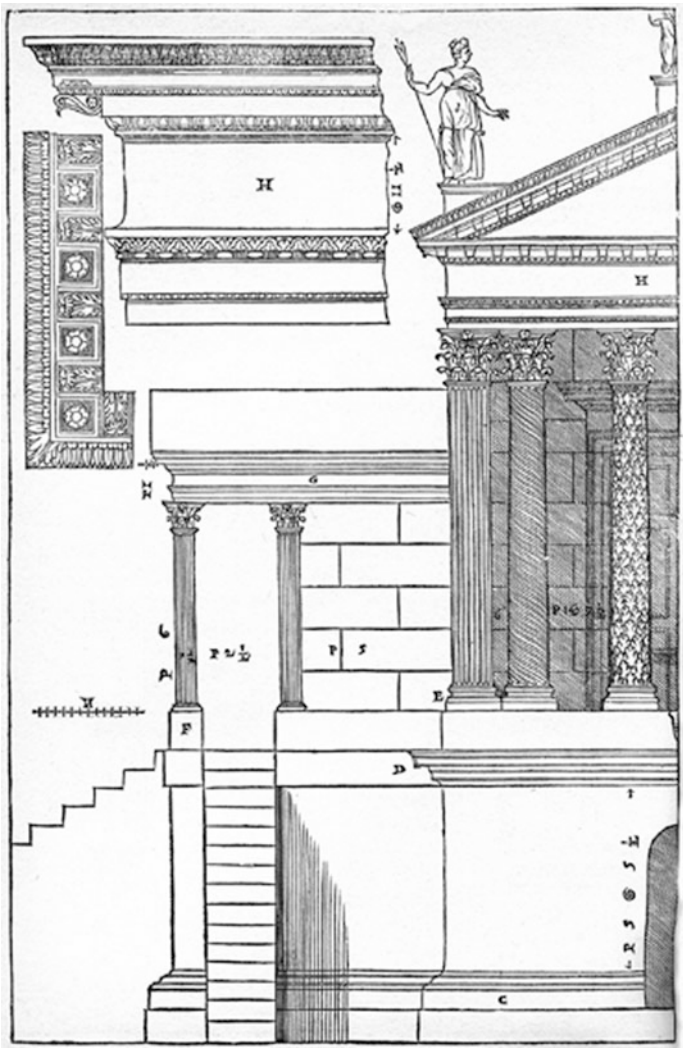

Fig. 7 Andrea Palladio, *Templo de Clitumno* (1570, 4: 100)

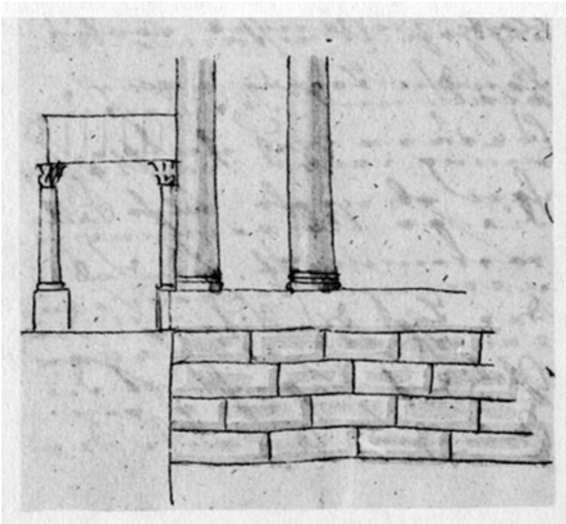

Fig. 8 Johann W. Goethe, (no title), 1795 (Femmel [1958] 1972, VIa: 155)

3 Conclusions

The comparison between text and drawings has allowed us to deepen in Goethe's architectural theory. Architectural drawings play in this theoretical system a central role, to the extend that it can be defended as means of knowledge and not just as mere illustrations. In this sense, text and drawings have similar value to that played in Renaissance architectural treatises.

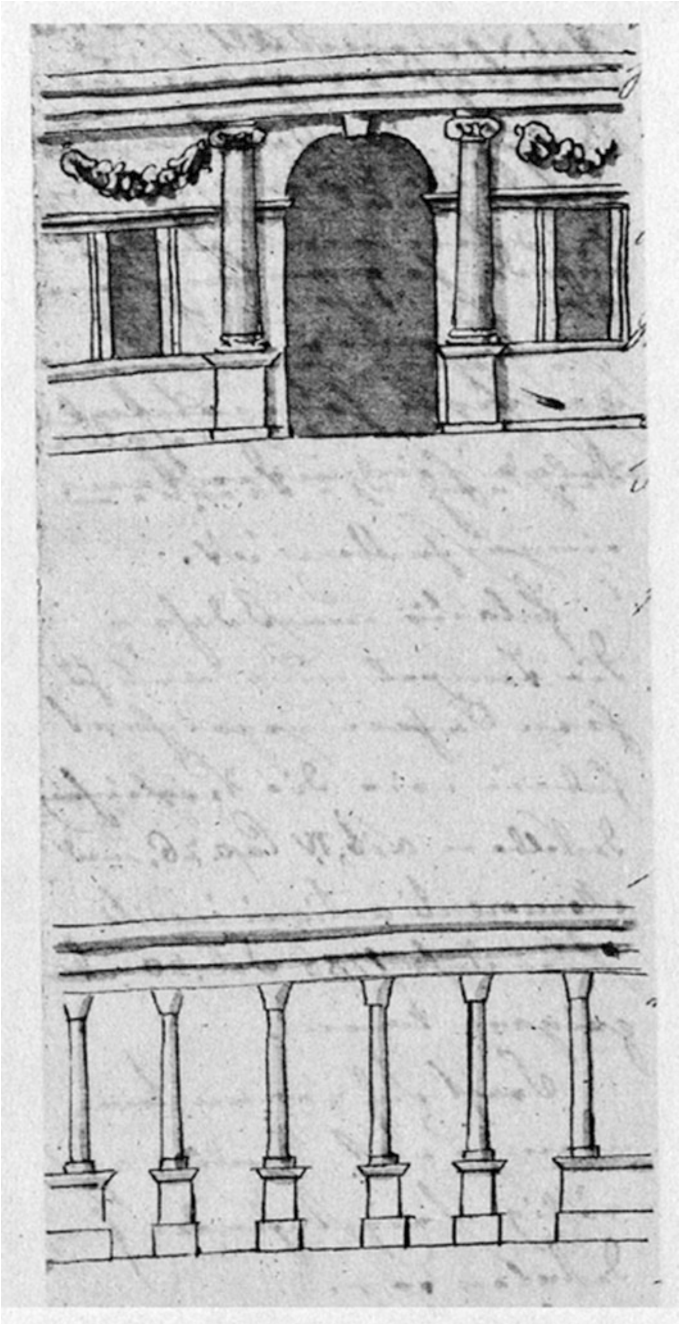

Fig. 9 Johann W. Goethe, (no title), 1795 (Femmel [1958] 1972, VIa: 155 rs.)

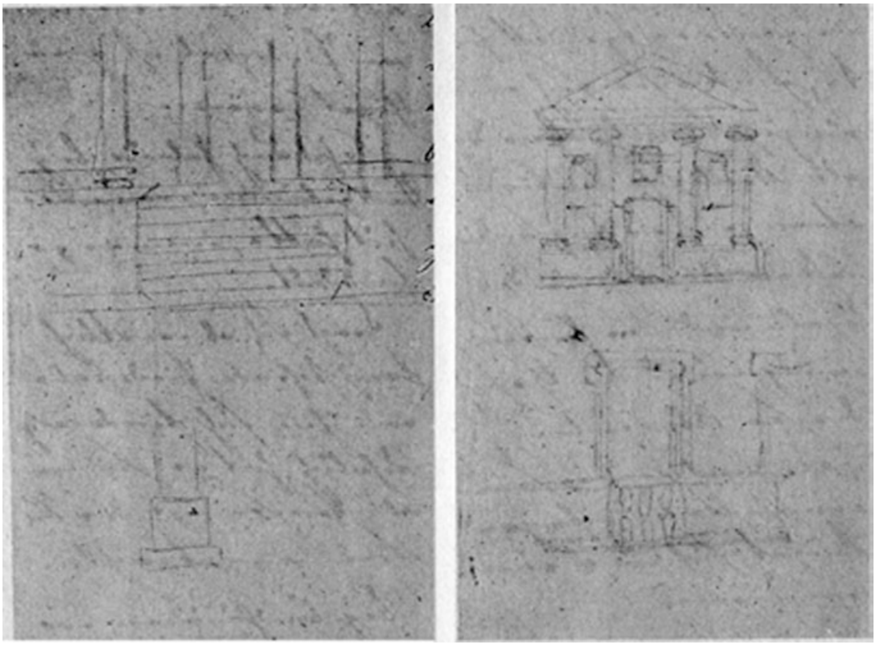

Fig. 10 Johann W. Goethe, (no title), 1795 (Femmel [1958] 1972, VIa: 156)

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Source

Goethe, Johann Wolfgang, *Baukunst, 1795.* Goetheund Schiller-Archiv (GSA 25/XLV, 6).

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Barbara Sokołowska Brukalski. Graphic Analysis of the House on Niegolewskiego Street

Starlight Vattano

Abstract The project analyzed in this paper by the critical and digital redrawing is the House on Niegolewskiego Street of 1927–28, designed by Barbara Sokołowska for her and her husband, Stanislaw Brukalski, inspired by the Neoplasticism ideas, the paintings of Mondrian and De Stijl. In its details the house seems to recall that one in Utrecht by G.T. Rietveld of 1924, with a very large living room, a studio overlooking a double height and a spiral stair connecting the two floors into one space defined by translated planes and pure volumes.

Keywords Representation · Graphic analysis · Barbara Sokołowska Brukalski

1 Introduction

Between 1920s and 1930s, Europe was characterized by a cultural, economic and political scene that involved the reconstruction of many cities, partly destroyed by war. In this social context in Poland was stimulated the formation of several avant-garde groups that carried on modern ideas, opposed to the previous Warsaw traditionalism, already exposed through CIAM, Werkbund, Bauhaus, De Stijl, Constructivism and Suprematism trends (Boscolo 2005; Quilici 1991).

After the first Polish avant-garde group, i.e. the Formists, in 1919–21 other groups, Blok and Praesens, characterized the architectural scene that began to affect architects and artists connected to the contemporary avant-garde visions. The main aim was to address social problems of that time through the track marked by functionalist thinking of the Modern Movement introduced in Poland by these nascent groups (Chionne 2005, 199–229).

Three groups distinguished above all within Praesens with the aim of creating low-cost housing and minimum dwellings in response to the emerging social issues (Malczyk 2002). One of the most emblematic figures of this Warsaw cultural

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revolution was surely Barbara Sokołowska Brukalski who, together with her husband Stanisław Brukalski, participated to the avant-garde activity of Praesens, acquiring many principles of the Modern Movement linked to the expression of functional rigor and the formal purity in architecture. Barbara Sokołowska graduated at the Warsaw Technical Academy (1921–1932) and began working with her husband in 1927, with whom designed some houses in Niegolweskiego Street between 1927 and 1929, participating at several international exhibitions including the 1st International Exhibition of Modern Architecture in Warsaw in 1926, the Modernists' Salon in Warsaw and Vilnius in 1928, the 1st Exhibition of Praesens in Warsaw in 1926 (Boscolo 2007). Another important collaboration for Barbara was with the architect Nina Jankowska in the '30s, with whom she designed the Dom i Ogród (House and Garden). After II World War Barbara Sokołowska was actively involved in the reconstruction of a new Warsaw building Pod Orłami Bank, Czapski Palace, interiors of the Old Town Square's buildings and even several churches.[1] Barbara Sokołowska joined the Praesens in 1929 and participated in CIAM 4 in 1927 beginning to interface herself with the emerging social issues. She was particularly inspired by personalities linked to the Russian Suprematism and as demonstrated by the issues covered in the quarterly Praesens, of which were printed only two numbers, and where were cited the works of Malevich, van Doesburg, Mondrian, Oud and addressed topics related to architectural utilitarianism, industrialization, prefabrication and standardization of building elements, as well as social and economic issues of building (Klosiewicz 2005, 157–198). Barbara's work, always reflecting the need for a minimum and functional space, is the result of a mathematical composition between geometry of the plan and neoplastic line of the building. Furthermore, embracing the new culture of the project related to the standardization process of construction and to the housing and economic needs of that time, she glimpsed in contemporary architecture the chance to approaching to building prefabrication and low-cost materials (Bojko 2005).

She constantly alternated professional activity with felt social and cultural commitment participating always with alacrity to the cultural revolutions of that time. She was the first responsible of several buildings in Zoliborz, the emblem district of the revolutionary ideas flow of polish architecture, where also worked important figures of Praesens in 1927 (Heynickx and Avermaete 2012, 96).

Barbara had a leading role among the members of the first generation of Polish women architects, and because of her fame and experience achieved over the years, she was the first woman in the Department of Architecture at the Technical Academy of Warsaw (Leśniakowska 2011).

One of her projects more linked to the polish avant-garde was the studio-house in Niegolewskiego Street designed in 1927–29, particularly influenced by De Stijl

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[1]Jerzyska k. Węgrowa, 1948-1965; Izabelin k. Pruszkowa, 1952; Troszyn k. Ostrołęki, 1956–1979; Ostrołęka 1958–1961; Sypniewo k. Makowa Mazowieckiego, 1969–1974. Cfr. Marta Leśniakowska, *The Brukalskis' Poetics of the Avant-garde*, in "Culture.PL", 2001 (Retrieved from: http://culture.pl/en/artist/the-brukalskis-poetics-of-the-avant-garde. 18.9.15).

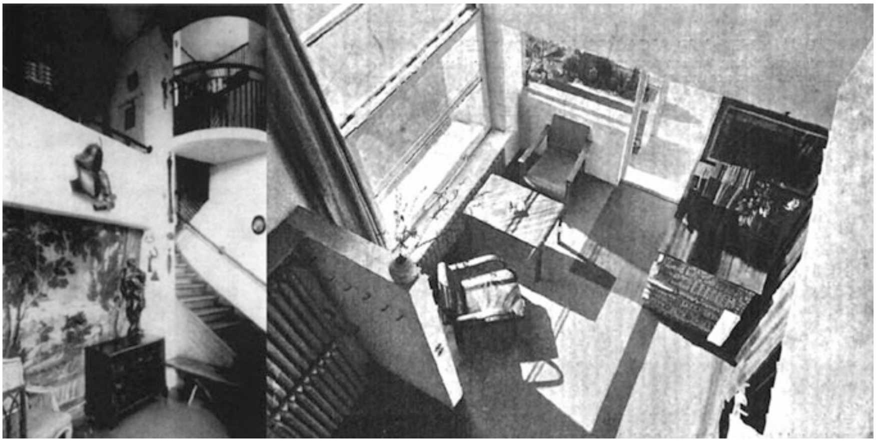

Fig. 1 View of the stair and double height living room of the House in Niegolewskiego Street

principles and inspired by the house in Utrecht, designed by Gerrit Thomas Rietveld in 1924 (Fig. 1).

This project was an expression form of the Polish architects' new generation that included names like Helena Niemirowska and Szymon Syrkus, Bohdan Lachert, Jozef Szanajca, Mieczyslaw Szczuka and Teresa Zarnowerowna or artists as Edgar Norwerth, Wladyslaw Strzeminski and Katarzyna Kobro, strongly influenced by Russian avant-garde (Klosiewicz 2005, 157–198).

Architecture was a path that Barbara knowingly undertaken with the aim of identifying in it a means to express ideas of a new aesthetic and synthesis of all arts.

As Helena Niemirowska did, another important figure of Polish architectural revolution, also Barbara in her work adopted a socio-architectural attitude in response to the Polish avant-garde issues. Indeed she handled different architectural scales, from the urban to the building one, also devoted herself to the furniture and garden design, since she studied at the Central Agricultural School.

Sokołowska belonged to the so-called second generation of architects, i.e. born after 1895, better known as youthful rebellion, but her idea of modern architecture did not fit completely with that one carried out by the leftist architects who converged in the avant-garde Block group (Marchi 2005). The socio-cultural environment where Barbara trained was particularly rich of international influences derived from academies of Vienna, Dresden, Karlsruhe, Graz, and Darmstadt, and Russian universities, especially from St. Petersburg; also because independence of Poland was proclaimed in 1918 and after that it started to define a new political condition after 150 years of subjection. In this context we recognize a mingling of traditional and vanguard architecture which characterized Barbara Sokołowska's project (Niezabietowski 1995).

The Polish pioneer saw a social responsibility in architecture consisting of a combination of classicism and modernism particularly influenced by the strong interest of her husband Stanislaw for the Italian futurism, and her studies carried on at the Central Agricultural School, addressed to a neo-romanticism that she always revisited in her gardens designs considered such as artistic natural elements: they were architecture quotations that defined a romantic spirit linked to the polish tradition with rigor and geometry of modern architecture project.

Barbara always saw the strong relationship between architecture and nature and between man and nature, in which she perceived an important urban element for the construction of public spaces open to all. Following the collaboration with her friend Jankowska, for the project of some interiors of the Warsaw Building Cooperative in Żoliborz, arose new composition issues defining a sort of manifesto of the new polish aesthetic, in which natural and tradition elements were mixed with pure volumes of modern architecture.

In this deconstruction and construction process of principles spread at international level, also several artists were involved from the Warsaw School of Fine Arts. Because of the close collaboration between art and architecture Brukalskis adhered to the Lad Visual Artists' Cooperative, which proposed a modern mingling among modern vanguard, folk motifs and traditional construction techniques (Leśniakowska 2011).

The project that best defines the work of Barbara Sokołowska was the Lounge Room for the Polish Pavilion presented at the International Exhibition of 1937 in Paris. It was known as airplane builder's room, furnished with the works of the sculptor August Zamoyski, influenced by cubism and futurism and with the famous chair covered with white sheepskin, combining vanguard, neo-romanticism and classicism.

Her style was unique and personalized, with soft furnishings, sinuous shapes and natural materials, together with a kind of primitivism that critics also admired for the audacity with which Barbara combined everything. Moreover, it was this attitude on the use of materials and shapes, tradition and avant-garde, which featured the new Warsaw expression and aesthetics of interiors (Tonini 2005).

You can identify another moment from which Barbara Sokołowska was the name of female architecture belonging not only to the Polish vanguard but also to that international one. Indeed, in 1927 she designed a kitchen for the residential housings Warsaw Residential Cooperative one year after Greta Schütte-Lichotzky made her Frankfurt Kitchen. As for the project of the kitchen, Barbara resorted to an innovative material at that time, linoleum, which revisited for the Compact Apartment Program of 1930, initiated by the Praesens.

Barbara Sokołowska kept in contact also with Le Corbusier, because of her involving in CIAM, who strongly influenced the Polish architect, as you can notice from her graduation project Apartment House of 1934, with two floors, large strip windows, spiral stair and walkways that reflected the traits of Maison La Roche-Jeanneret in Paris of 1924. The eclectic style of Sokołowska is also evident from the detail of her interior designs, often with quotes from the Charlotte Perriand's projects and ideal housewife guides thinking of an architecture which took into account the needs of man and at the same time that ennobled everyday architecture.

After II World War Barbara with her husband tried to transmit their knowledge to the students of the Department of Architecture at the Warsaw Technical Academy according a multifaceted teaching methodology treating different issues of architectural design, regardless of the scale. She published also a textbook summarizing her ideas entitled Principles in Designing Housing Estates in 1948 but it was withdrawn from circulation because of political reasons.

Many were the contributions of Barbara Sokołowska to polish modern architecture. Her consistency in the design of domestic space, functionality of laboratory-kitchen type designed in 1930 and used until the ‘80s by offices in Poland, elegance of gardens designs and the comfort of her furniture, were elements that defined her revolutionary position both for the interior design field and for different scales of architecture, mostly in the period between the two world wars.

2 Graphic Analysis of the House on Niegolewskiego Street (1927–28)

The project here analyzed through the redrawing as a methodology of critical knowledge deals with the House on Niegolewskiego Street of 1927–28, located in the same neighborhood where, with her husband, Barbara realized some dwellings. The mixture of De Stijl outside and the interior strongly influenced by lecorbuserian project took critics to define her project the most emblematic example of modern architecture in Poland (Leśniakowska 2011). The studio-house designed for her and her husband, is on three floors with a practicable flat roof (Fig. 2).

The graphic interpretation is based on the study of three plans of the original project and one elevation, in correspondence of the main entrance. In these drawings there are notations of dimensions only into two rooms: kitchen-living room of the ground floor (corresponding to the long side of one of the two rectangles that constitute the base of the entire volume) and the studio on the first floor.

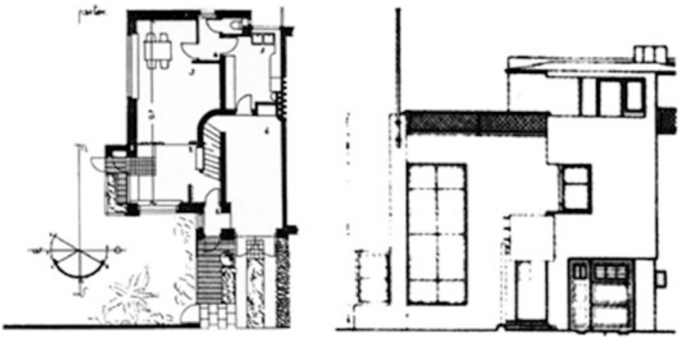

Fig. 2 Archive drawings of plans and the elevations of the House in Niegolewskiego Street

From other annotations you can identify the functional organization of the house and a clockwise progressive numbering, starting from the main entrance. In the ground floor you can identify a double height living room, with a jutting covered terrace almost entirely glazed and one window that looks onto the garden, a recalling of her Central Agricultural School studies; a dining room, with a large window that probably Barbara Sokołowska had placed to take advantage of the natural light; a hall, which gives access to a bathroom and a kitchen, and finally a large space also accessible by a second entrance where there are not furnishings notations.

The first floor plan shows the numbering that identifies three rooms accessible from the stair: the studio illuminated by a large window of the same size of that one in the kitchen; the bathroom and the bedroom with a small terrace. The third floor, in correspondence of the practicable flat roof, with a not furnished room, and a window which holes the projecting volume of the base rectangle.

The fulcrum of the project is represented by the staircase around which are developed in a centripetal way interior spaces. A translation and rotation movement that almost seems to reverberate the vertical action on the other elements of the architectural volume, starting from the sliding of the two base rectangles that glide in correspondence of the staircase and break perpendicular planes which delimit the skin building. They are elements that mark movements of planes such as the rotation caused by the ascent around the center of the house, or translation, in the small terrace of the first floor of the rail suspended over the flat and held with only two steel tubulars, neoplastic quotation that make lighter and more transparent the flatness of vertical space with respect to the building footprint (Figs. 3 and 4).

The rhythm of the floors scanning is also horizontally traceable, indeed, the slippage of the surfaces determines the definition of other points of view, as an extension of the roof on the short side which shows the deviation between the two rectangles giving the chance to turn around the large volume of the staircase.

The motif of the stair is an element of visual balance in the drawing of the façade on Niegolewskiego Street that can ideally be divided into two main areas, that one of the large glazed surface of the dining room on the ground floor and the studio on the first floor and which one at the second floor that on the vertical axe tracks other small openings staggered between them. A sphere placed in front of the main entrance expresses before entering the house an idea strongly linked to the rotating incessant movement, the same of the staircase. Furthermore, it states the idea of space of Barbara Sokołoska: pure volumes, white color and plasticity of form (Fig. 5).

By redrawing these archive drawings it is possible to understand some of the intimate features of the project, scanning of spaces, attention to the interior lighting, the double-height living room that in the tridimensional view maintains the fluidity of space already perceived through plans and functional distribution of spaces developed around the staircase, a real walk in the house which keeps the visual control within a vertical shift. The redrawing included the revision of three plans and elevations and two sections crossing the staircase, both longitudinally and transversely, to catch the composition changes of project (Fig. 6).

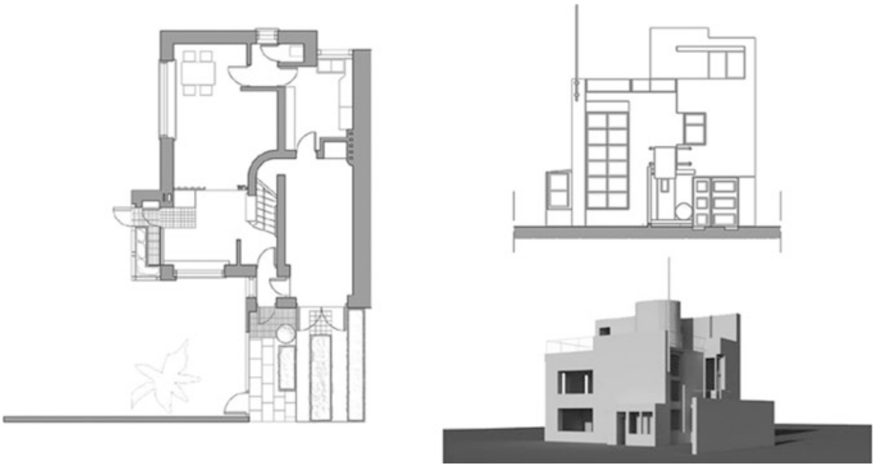

Fig. 3 Redrawings of ground floor plan, main elevation and perspective view

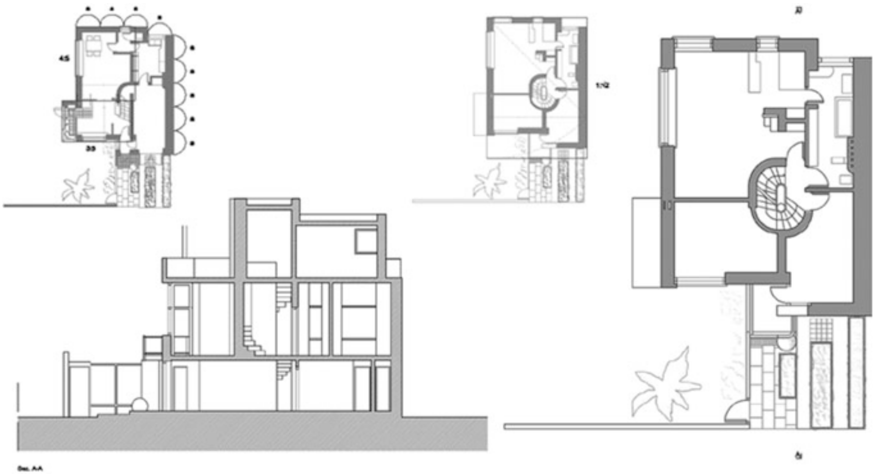

Fig. 4 Redrawing of first floor, longitudinal section and harmonic ratios

This graphic information are supported by a study on harmonic relationships traced within the project of Barbara Sokołowska, in plans and elevations, which allowed the understanding of the archive drawings through an interpretive reading on spatial and proportion rhythm of architecture. Indeed, the plan of the ground floor is inscribed in a diagonea (ratio 1:$\sqrt{2}$) that includes a golden section in the rectangle with larger area; it has been traced the repetition of a reference module for 5 times in the long side of the plan and 4 times in the short side (Fig. 7).

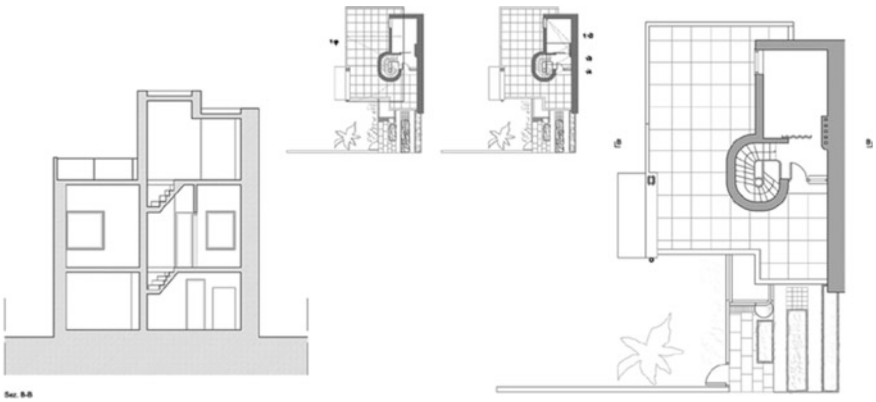

Fig. 5 Redrawing of roof plan, section and harmonic ratios

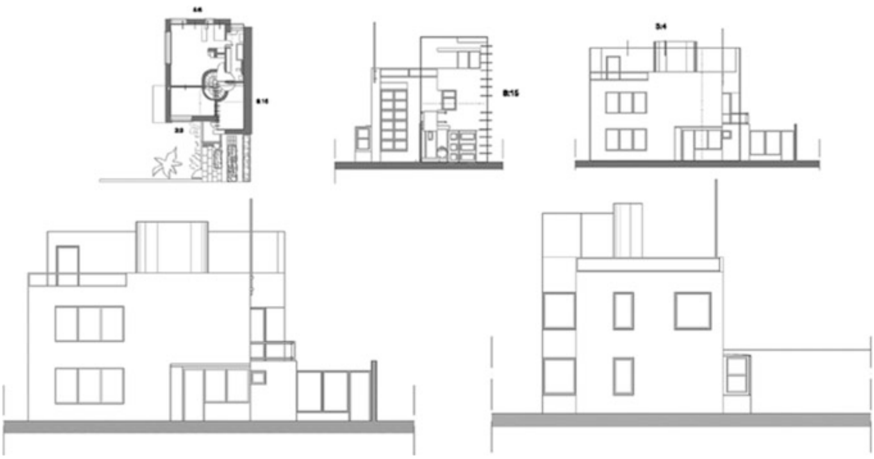

Fig. 6 Redrawing of elevations and harmonic ratios

Also they were inscribed in harmonic relationships, such as a major sixth (ratio 3:5) in the living room and a major third (ratio 4:5) in the dining room, at the ground floor plan; while in the plan of the first floor a minor third (ratio 5:6) in correspondence of the studio and bath, a double diatessaron (ratio 9:16) in the bedroom and a diapente (ratio 2:3) in the double height space have been traced. The volume that protrudes in the roof, in correspondence of the blind wall of the building in the series of four dynamic rectangles (ratios $1{:}\sqrt{2}$, $1{:}\sqrt{3}$, $1{:}\sqrt{4}$) has been inscribed. Even in elevations two harmonic ratios have been traced, in the main one a major seventh (ratio 8:15) and in the lateral one a diatessaron (ratio 3:4).

Other drawings produced to investigate the project Barbara Sokołowska project in its spatial complexity include two axonometric projections, which in their wire frame definition hold the three dimensions around one point, the origin of the

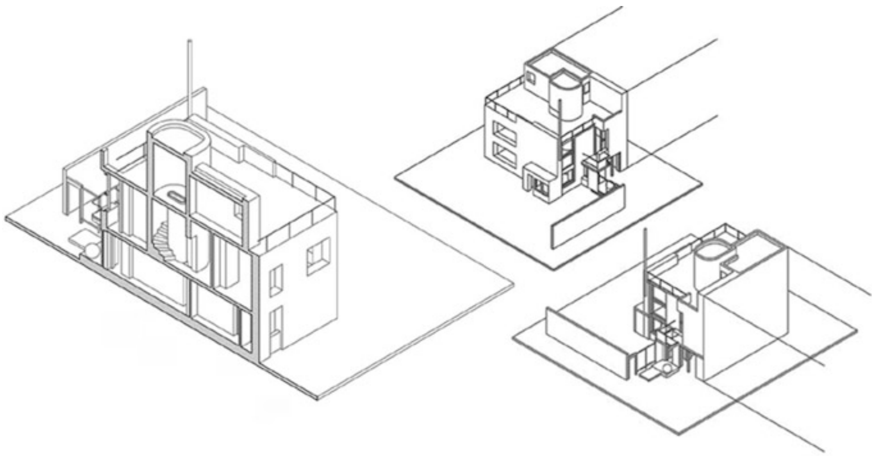

Fig. 7 Axonometric section and axonometric projections of the studio-house

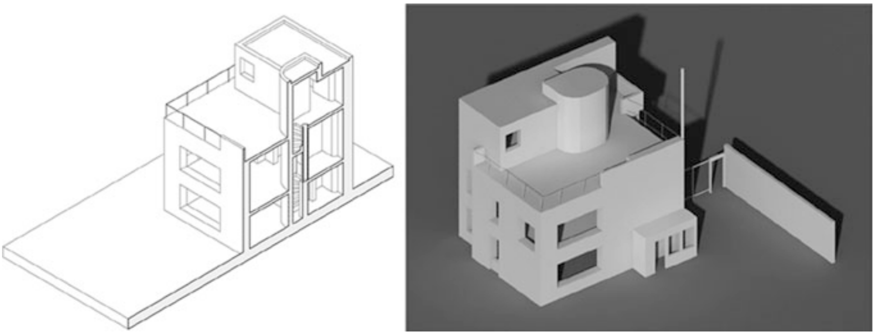

Fig. 8 Axonometric section and axonometric view of the house

geometric structure and at the same time recall the centripetal movement caused by internal staircase and reverberated on the external volumes. In the two isometric views, the volume has been cut in correspondence with the staircase, to dissect architecture in its spatial shifts between the inside and the outside of the house (Fig. 8).

But it is in the exploded view that the Barbara Sokołowskas project is broken down to show the metric-spatial ratios that exist between the two-dimensional view of plan and the three-dimensional one of axonometric view; a graphic synthesis which, together with other orthogonal projections, define one of the different knowledge phases of the project (Fig. 9).

The drawings presented as a further step in the graphic study include two renderings in an isometric view from above, that capture the volume complexity and the spatial organization of the project; three perspective views with a height of

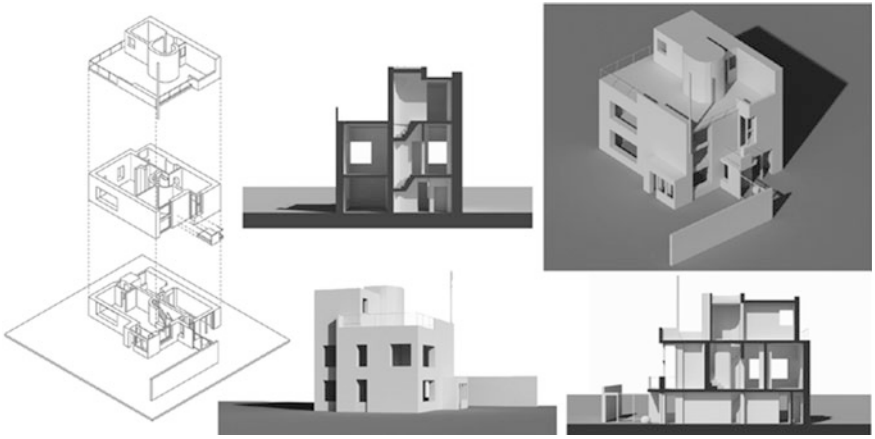

Fig. 9 Exploded view, axonometric views, perspective sections

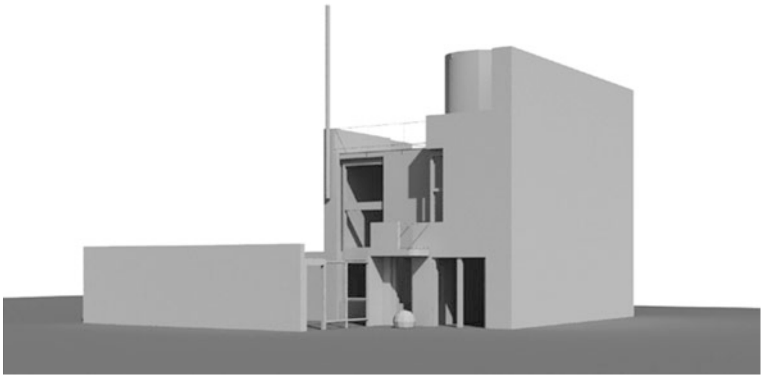

Fig. 10 Rendering of the studio-house

1.70 m to track the visual contact and the relationship between man and architecture recognizing the space around the building; the last two drawings include two perspective sections that enrich the information provided by section through the sense of spatial depth of perspective (Fig. 10).

3 Conclusions

The pioneering work of Barbara Sokołowska defined in Poland between the two world wars a new feature and compositional practice of architecture, closer to the elements that characterize the Modern Movement and the artistic avant-garde already internationally spread. Knowledge related to modern architecture of international style and the revolutionary air breathed during the entire period of her training characterized the figure of one of the modern movement pioneers who had actively participated to the definition of a Polish style steeped in volumetric purity and innovative materials, for one hand, and in Warsaw traditionalism and neo-romanticism from the other one.

The study of Barbara Sokołowska project, through the slow and inquiring eye of drawing, allowed to trace further handwritings of Polish architect, providing digital interpretations of an eclectic, revolutionary and interested to the needs of the time architecture's figure.

The white volumes described in renderings represent a further moment of reflection about the spatiality interpreted by archive drawings that deliberately describe pure architecture, in which solids and light build a new project, that takes form through the graphic interpretation in the silence of paper, crystallizes the contemporary handwriting and creates a new starting point for the knowledge of the Barbara Sokołowska project.

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Graphic Analysis of the Late Gothic Pillars of Hernan Ruiz "The Elder"

Pilar Gimena Córdoba

Abstract This paper is part of a wider Ph.D. research in which the architecture of Hernán Ruiz "the Elder" is analysed. Some of its conclusions are overviewed in this paper, like the use of architectonic drawing as an historic analysis tool. In this case, analysing the graphic criteria in a main element in particular: the pier.

Keywords Drawing · Analysis · Hernán Ruiz "The Elder"

From 1525, the architectural trend began to change promoted by a group of architects who were able to accomplish their work to both languages, Roman and Gothic: Rodrigo Gil de Hontañón, Alonso de Covarrubias, Diego de Silóe, Juan de Álava, Pedro Machuca o Hernán Ruiz "the Elder". These maestros were sort of connoisseurs of the Renaissance architectonic theories, of the buildings from the Antiquity and of their sense of order, promoting a change in the architect education. All of this took shape in Castile around the decade of 1560, when a group of maestros in their thirties, who were born around 1525, developed their work. A generation supported by the government of Felipe II, in which the figure of Juan de Herrera highlighted.

It was in this transition environment that involves the new trends, when Hernan Ruiz "the Elder" developed his professional work (Gimena Córdoba 2014) mainly between 1500 and 1547 (year of his death).

This research is part of the National Plan for research project I+D+i Gótico catedralicio sevillano: arquitectura y ciudad en los ámbitos de influencia de la catedral de Sevilla (Seville Gothic cathedral: architecture and city in the areas of influence of the Cathedral of Seville) (Ref: HAR2012-35152) Principal investigator: Antonio Luis Ampliato Briones, University of Sevilla.
Ampliato et al. (2006, 2010).

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When it comes to research about the architecture of Hernan Ruiz “the Elder, we find a broad diversity of opinions. Agustín Azcárate Ristori (1993) defined Hernan Ruiz I as “a medieval old-fashioned quarry worker”. De la Banda y Bargas (1974)” as a “delayed gothicist educated in the Catholic King and Queen style, like his father”. Villar Movellán (1986) as a “Gothic humanist”. Suarez Garmendia (1975) as “the last connection step between the Gothic of the Catholic King and Queen and the style traditionally called Plateresque”; and Molinero Merchán quotes him as a “thoroughly Renaissance maestro in the Belalcázar palace” (Molinero Merchán 2011, 405).

This variety of opinions have a point in common: all of them agree in the statement of his structural and material knowledge as a good medieval quarry worker, this maestro had.

Based on the works developed by the research group HUM-799, Strategies for a heritage knowledge, the methodology used for this paper starts, in a first place, with the localization of the position of every studied pillar. To that effect, it was stablished a spatial reference system in every analyzed floor-plan (Ampliato et al. 2006, 232).

The axes of the walled plans that formed the church were considered in order to name the transversal lines of the main nave with numbers and the longitudinal ones with a letter. The result is a grid in which all the lines intercept each other in different supports, giving a letter and a number to every one of the pillars.

From this reference system we configure the different type of pillars (Pinto Puerto 2006, 247–253) and each geometrical sketches is separately analyzed.

Subsequent, as a contribution to the study of the work of Hernan Ruiz “the Elder”, we are going to present the most significant cases and pillars of this maestro. The church of San Mateo in Lucena and the church of Santa Maria la Mayor of Baena, both in the area of Cordoba. These temples began their construction in the first decades of the 16th century, in a Gothic sphere.

During the curse of their construction, they evolved, displaying elements that reflects the maestro inquisitiveness about the language transition, between the late Gothic and the Classicist.

1 Church of San Mateo in Lucena

This temple is configured following the traces of the Fernandines churches of Cordoba (García Ortega 2009:104). It is organized in three naves, a central one and two lateral ones, almost with the same height.

There are three types of pillars, all of them cut in the same material, sandstone (Fig. 1).

The first group (type 01) is composed by the pillars that configure the block of the temple naves. The second type (type 02) is found in the walled box of the chevet

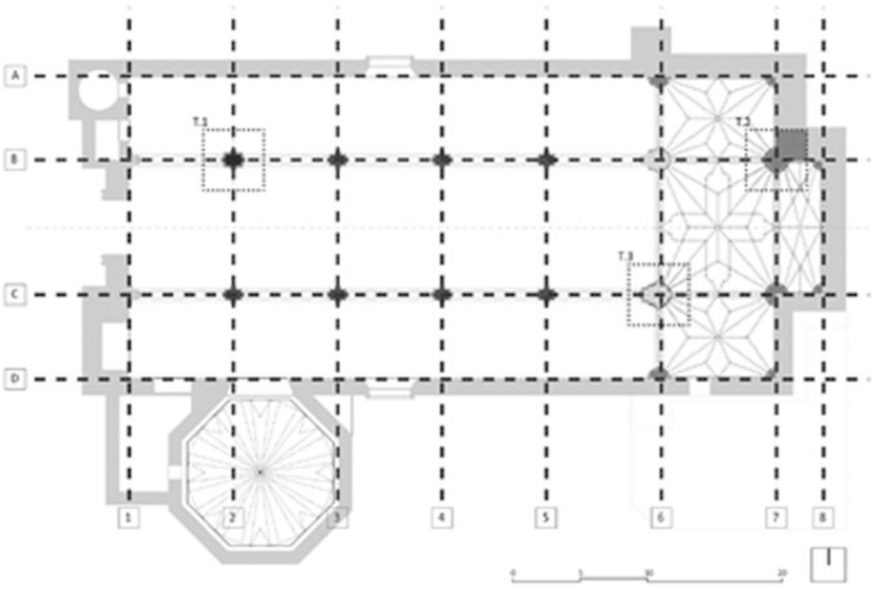

Fig. 1 References system and typology of pillars in the church of San Mateo in Lucena (Cordoba). Drawing by the author. 2014

and the last one, the third one (type 03) is formed by the only two pillars located between the chevet and the central nave, as a result of joining the type 01 and type 02.

1.1 Pillars Type 01

The fist type is located in the naves of the church, they are B1, C1, B2, C2, B3, C3, B4, C4, B5 y C5. In this case, they respond to a Classic language. They have a rectangular section, with half pillars attached in every face. This central symmetry is a meaning fact in the configuration of these pillars, because they only receive arcades in the principal direction of the naves, and not in the transversal one. The rectangular geometry is significant, as we will see later (Fig. 2).

Opposed to the Gothic organic continuity of the lines between pillars and vaults, the classic formation of this pillar, though it is not obvious, introduced an isotropy factor in this space of the naves.

The only decoration used in this design is in both sides of the rectangular section. This ornamentation is based on the disposition of a counterbore that goes along the pillar. This counterbore is divided in two, in each side of the support, by the attached half column we have mentioned before. They are covered in their lower part by a unique base that surrounds the whole section.

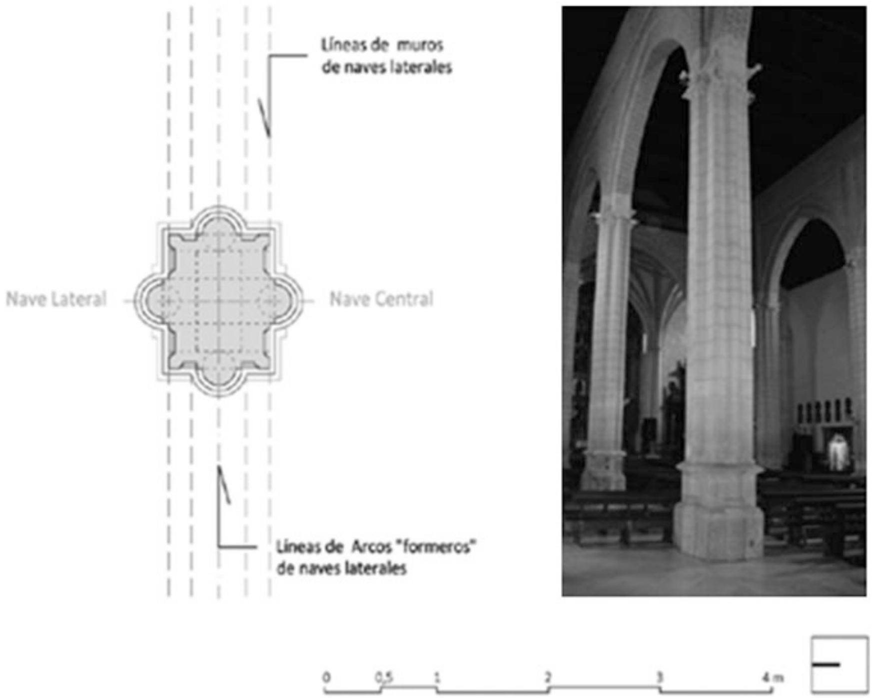

Fig. 2 Configuration and groups of *lines* in the pillar type 01 of the church of San Mateo in Lucena (Cordoba). Drawing by the author. 2014

1.2 Pillars Type 02

The second one is located in the chevet of the church: A6, A7, B7, B8, C7, C8, D6 Y D7. They support the loads of the cross vaults.

None of them was properly configured as a pillar in the sense of a free-standing column, because they are more or less attached to the walls. Nevertheless, we have classified them as a particular typology of pillars, due to the fact that their formal configuration is always the same, beside of their relative position in relation to the wall, where they are attached.

Thus, we consider a unique type of pillar that shows part of itself to the exterior when it is attached to the wall. When it is attached to a flat wall, it is configured with a half-pillar; if it is attached to a closed corner, it is a three-quarters-pillar. This last one is the case of those pillars that sustaine the rotunda which separates the false transept and the apse vault (Figs. 3 and 4).

Although Hernan Ruiz "the Elder" could solve the support of the vaults on corbels by attaching them to the perimeter walls, he did it with this type of supports. It was this decision that led us to mark them as an independent support typology, which defines in a formal way, the late Gothic supports of this building.

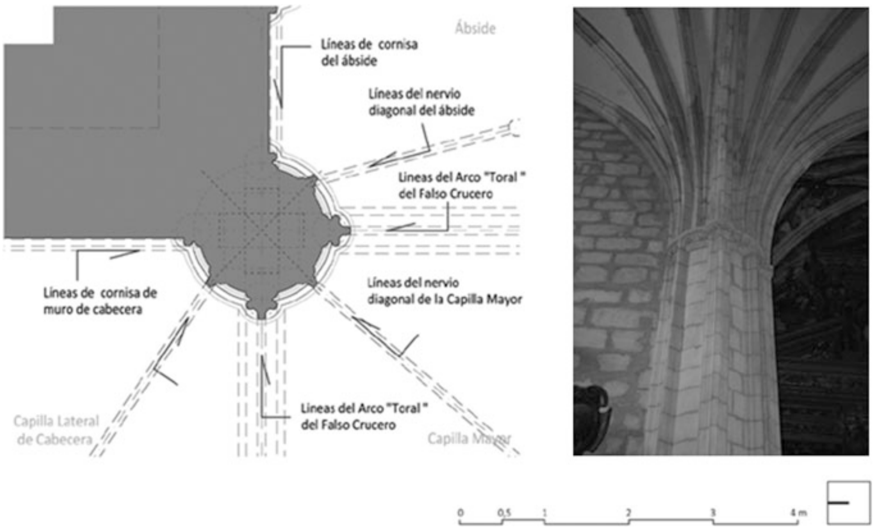

Fig. 3 Configuration and groups of *lines* in the pillar type 02 of the church of San Mateo in Lucena (Cordoba). Drawing by the author. 2014

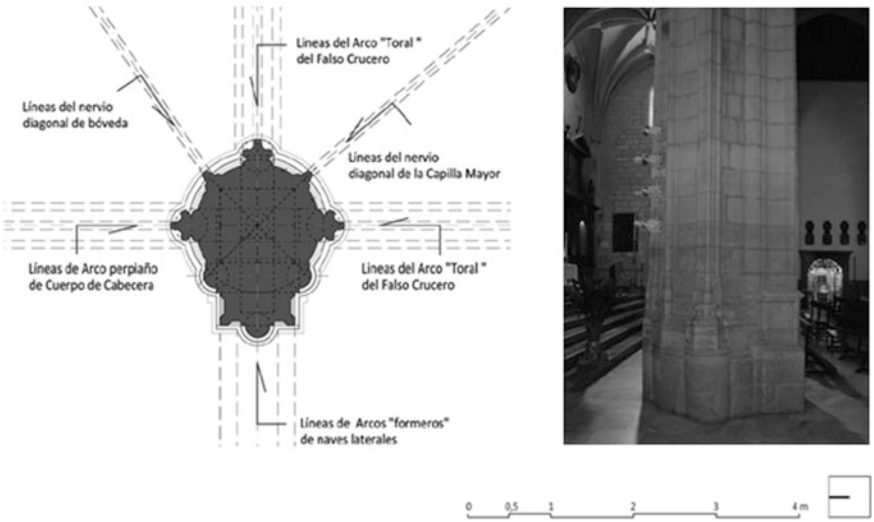

Fig. 4 Groups of *lines* of the pillar type 03 of the church of San Mateo in Lucena (Cordoba). Drawing by the author. 2014

This type of supports is composed by little columns and mouldings that runs along to the continuous capital, decorated with a thistle leaf. From here the nerves of the cross-vault start. In its lower part, there is a unique base which surrounds, like a corset, and from which begin each one of the mouldings with their own base, in groups of three depending on the pillar section.

1.3 Pillars Type 03

The last pillar, maybe the most interesting one, is the result of the fusion of the previous ones.

They are two pillars, located in the limit of the chevet with the rest of the naves in the central area, B6 and C6. The side of the pillar that faces the naves correspond to type 01, while the other side, the chevet, responds to the second one (Gimena Córdoba 2015, 235).

These two pillars are fundamental in order to study and analyze this work, because they mix the late Gothic language with the Classic one.

If we closely observe the union between both sides, there is no evidence, alteration or modification in these pillars, from their base to their top, in the vaults or in the arches that support them. That is why we can confirm that they were traced and designed by the same person. They are not the product of the union of two pillars, they are a unique pillar, conformed with pieces of both languages, and cut at the same time. The capitals are located in a stepped way so they do not get conflict with the others and the base is even leveled with the classic part of the pillar where the Gothic moldings start, in order to give it slenderness (Figs. 5 and 6).

Due to the fact that those pillars needed to be constructed before building the vault, it is possible to affirm that the late Gothic pillars and the supports of Classic language were made by the same person, or at least, the person that gave the orders.

After proving the authorship of these three naves that configures the chevet (Villar Movellán 1993) we can attribute these "Classic" pillars to Hernan Ruiz "the Elder", because it would have been impossible to build those vaults without building also the pillars that support them.

There are two similar cases that can be appreciate in the first pillars of the block of naves in the Church of the Asunción in Bujalance, Cordoba, built by Hernan Ruiz "the Young", and in the pillars of the cross-dome in the Church of San Miguel Arcangel in Moron de la Frontera, Seville. The first one, although it is very alike in its design, is completely different in its conception. In its trace there is no continuity in the union of the two parts that configures these pillars, one in late Gothic language and the other one in Classic.

In both of them the lines that define the bases, the borders of its intersection or even the ornamentation ofboth volumes, shows that they were built by different persons, in opposition to the other case in the Church of San Mateo in Lucena. On the other hand, the rest of the pillars of the block of the nave in the Church of the Asuncion in Bujalance were conceived as a rectangular section, with two columns attached to the smaller sides, because they support the arches of the walls in the central nave.

Fig. 5 Configuration of the pillar type 03 of the Church of San Mateo in Lucena (Cordoba). Drawing by the author. 2014

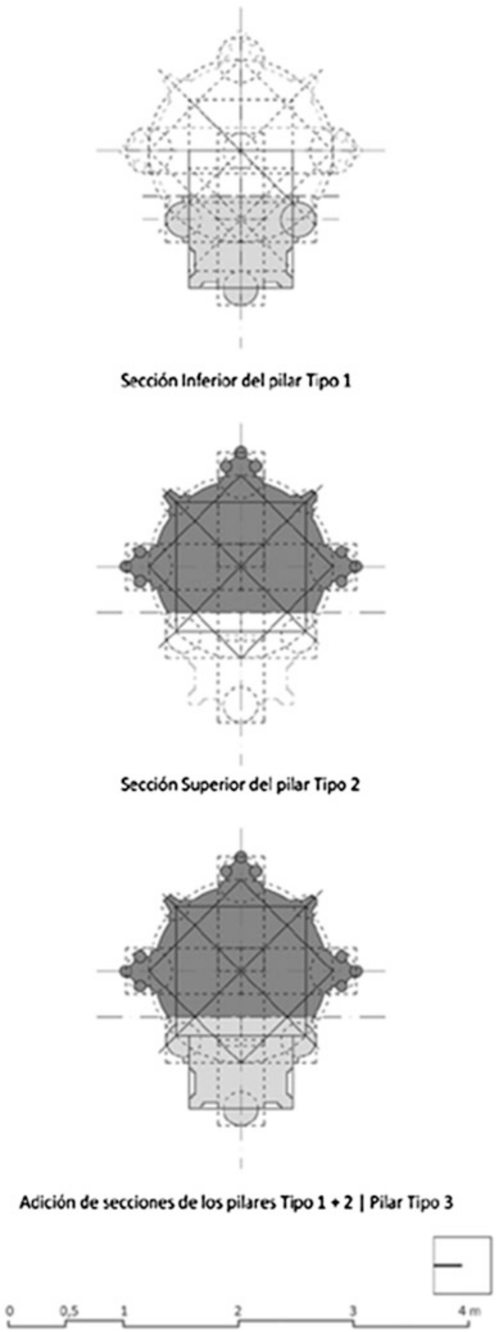

Fig. 6 Pillar of the church of the Asuncion in Bujalance, made by Hernan Ruiz "the Young". Author photograph. 2013

In this case of study, the Church of San Mateo, the supports type 1 of the naves, already commented, were projected with the same rectangular section, but in this case, there are columns attached in every side, so it acquires the section of a cross.

The second case corresponds to the pillars of the crossdome in the Church of San Miguel Arcangel in Moron de la Frontera, Seville, probably made by Martin de Gainza between 1550 and 1556 (Fernández Naranjo 2007, 318, 311). The plan of the pillar is similar to those in Lucena, with a perfect fusion between the Roman part and the late Gothic one.

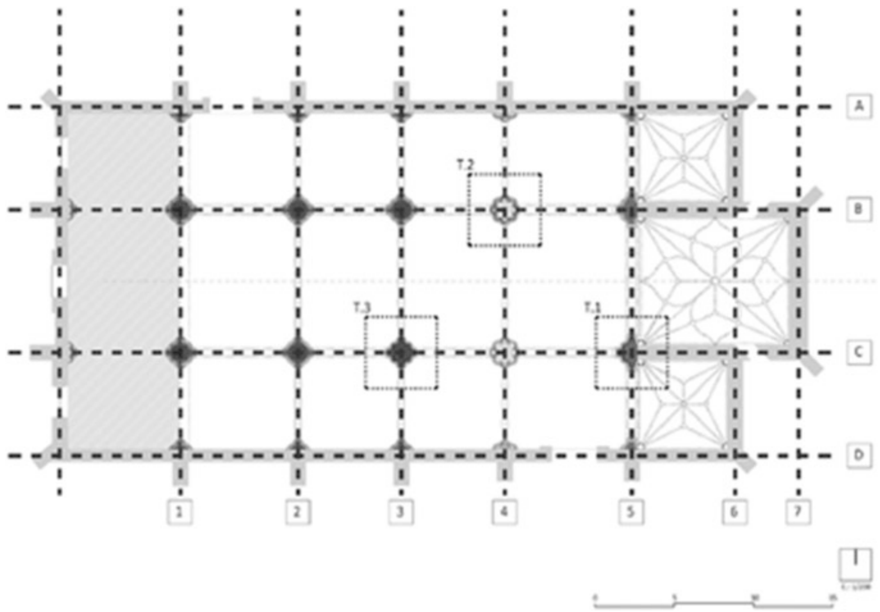

Fig. 7 Reference system and typologies of pillars on the plan of the Church of Santa Maria la Mayor in Baena (Cordoba). Drawing by the author. 2014

2 Church of Santa Maria la Mayor in Baena

This temple, with a Gothic origin, was first composed by three naves, without a cross-dome, and a flat chevet with a high chorus, currently disappeared.

Similar to the last case, we find three types of stone pillars included in this church (Fig. 7).

The first group (T01) is configured by four pillars that compose the main transversal portico which separates the chevet from the rest of the naves of the Church of Santa Maria. The second one (T02) is configured by the line of pillars that compose the next transversal portico, which is parallel to the last one, before those of the chevet; the third group (T03) is configured by the pillars that conform the last naves of the temple.

The configuration of this types of pillars is similar, but the variation is in the section of each one of them (rhomboid shape the first and the third group, and octagon shape the second) and in its formal complexity. To summarize, we could say that the third type is a simplification of the first and second one in relation to the grade of its complexity in the design.

All of them were designed with small columns and mouldings that runs up high to a capital decorated with a thistle leaf. Depending on the side of the pillar, the height varies. If we look to the side of the pillars that delimited the central nave, the height goes up to almost the roof, to a great cornice that runs along the perimeter of the temple.

In the other side, those of the lateral naves, the columns ends in small capitals. Above them, the unique nerve that configures the cross-vault in this sector, starts. It was in the 17th Century when the starts of the naves vaults were cut and covered with Churrigueresque ornamentation (Aguayo et al. 1992, 1:251) as we can currently appreciate in the Church of Santa Maria.

In its lower part there is a unique base which rolls them as if it were a corset. From here starts each one of the mouldings with its own base, which remember (in the case of the type 01) to those of the transept of the cathedral of Cordoba, which begin to be built in 1523 (Ramírez de Arellano 1902, 560).

2.1 Pillars Type 01

We can find the first type in the chevet of the church.

They are the supports of the loads of the cross-vaults in the chevet. This group is composed by 4 supports, A5, B5, C5, D5. None of them was configured as a pillar itself, in a way of a free-standing column. Nevertheless, like in the church of San Mateo in Lucena, we have classified them as a particular typology of pillar, due to the fact that their formal configuration is always the same, independently of their relative position in relation to the wall where they are attached, and because they were the grounds of another support typology.

So we consider in this typology a unique pillar that when it is attached to the wall, it shows to the exterior its own section, a result of the intersection with the walls; when it is attached to a flat wall, we find that the result is a pilaster configured as a half pillar, and if the corner is opened, the pilaster is a three-quarters pillar. This last case is related to the pillars that support the arches that form the rotunda, which separates the main chapel from the block of naves.

2.2 Pillars Type 02

The second of them is located in the nave previous to the chevet of the church. This group is made by four pillars, A4, B4, C4 and D4.

They are octagon shape pillars with complex basements decorated with garlands of flowers, which add a formal complexity to the last type. In them, the small columns increases the number, although they follow the same structural outline of the last group, on the lobed bases with the flat side, where depending on the side, the shape and structure change.

In the original project this pillars were those which supported the forces transmitted by the corbels of the vaults.

2.3 Pillars Type 03

The third and the last type is located in the last naves of the church. They are B1, C1, A2, B2, C2, D2, A3, B3, C3 and D3.

In this case, the pillars are configured again by a rhomboid shape section. Small columns are attached in each one of the vertex and sides. It looks like they repeat the outline of the pillar type 01, but there are some details that suggest that they are the result of a revision and a simplification in relation to the type 02, due to the alteration of the configuration and number of bases of the small columns and mouldings. This fact was repeated in the free-standing pillars, in the vertical continuation of these pillars on the walls of the central nave and in the pilasters attached to the walls of the lateral naves.

The distinctive feature about this pillar is the configuration of the small independent bases which work as the beginning of the small columns attached to the pillar. Its trace and height will be repeated in the pillars type 02, located in the parallel line of the supports. Each one of these bases, with a hexagonal generatrix, shows a flat side over the corset with the rhomboid shape section that surrounds the support. It is the same in the supports type 02, independently that in this case, the base of the support has an octagon shape (Figs. 8 and 9).

This simplification equally affects the configuration of the corbels located at the same height of the cornice that runs along the whole central nave, prepared to receive the vaults that should have existed on them (Valverde Y Perales 2007, 291; Ampliato et al. 2010, 91; Villar Movellán 1993, 490); even though the pillar type

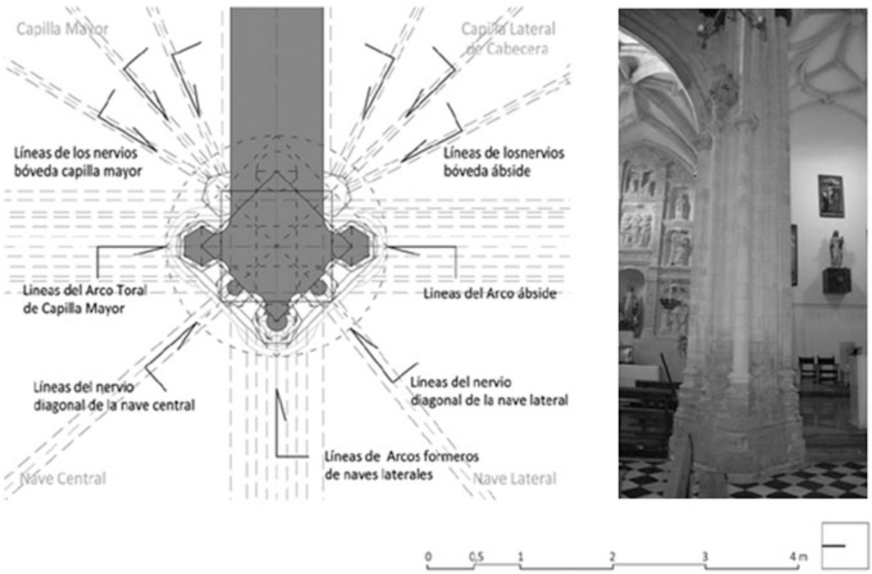

Fig. 8 Configuration and groups of *lines* of the pillar type 01 of the Church of Santa Maria in Baena (Cordoba). Author drawing. 2014

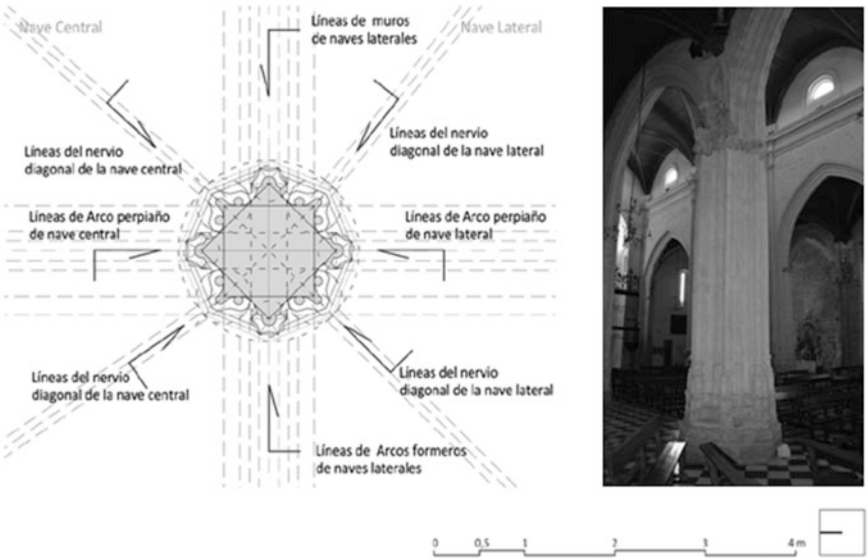

Fig. 9 Configuration and groups of *lines* of the pillar type 02 of the Church of Santa Maria la Mayor in Baena (Cordoba). Drawing by the author. 2014

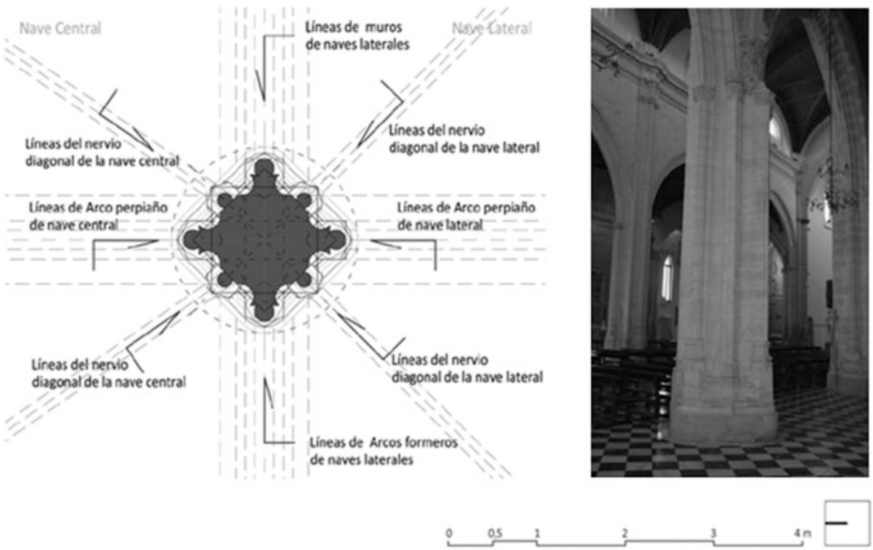

Fig. 10 Configuration and group of *lines* of the pillar type 03 of the Church Santa Maria la Mayor in Baena (Cordoba). Drawing by the author. 2014

01 and type 02 has corbels on them disposed as starry canopies orientated with a point to the exterior, similar to those, for example, of the nave of the church of the hospital of san Sebastian in Cordoba, where de corbel on the pillars type 03 is configured as an extension of the cornice which is larger to the interior of the nave (Fig. 10).

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Author Biography

Pilar Gimena Córdoba Dr. architect and researcher at the Department of graphic expression of the school of architecture of Seville. *Among the most relevant publications quote the article Graphical analysis of four spaces designed by Hernán Ruiz* "*The Elder*" in the journal EGA n° 26, pp. 232–241, *the article Technical study of the ceiling ornamentation from the meeting room of Seville city hall*, in the scientific journal Materiales de construcción Vol. 60 n° 297, pp. 83–95 y VAR JOURNAL, *Architectural thought and graphical criteria in the modeling of the space. Some cordoban projects of Hernán Ruiz* "*The Elder*". Vol. 5, N° 11, pp. 5–13. My work focuses on research of ecclesiastical buildings of the late Gothic Cordoba, taking as starting point the study on Hernán Ruiz's work "the old" and using criteria and techniques typical of the architectural analysis and management of drawing as a tool for historical analysis.

Drawing in Architectural Research: Drawing in Paestum

Juan Manuel Báez Mezquita

Abstract A particular type of architecture travel sketch consists of images made with a dual purpose: for the author, as a means to analyse and learn about the architecture represented and to create documents to transmit the essence of this architecture to other people. Such drawings must show the characteristic values of the buildings they represent, and they should be made using the most adequate graphic means, as well as the most explicit viewpoints. In order to be able to draw in this way, a certain prior architectural culture is needed to help in the choice of the best and clearest images for teaching. This prior culture will also feed on all the information obtained in the observation process, something which is vital to the creation of the drawings.

Keywords Travel sketch · Watercolours · Paestum archaeology

In the faculties and schools of architecture, there is currently a preoccupation with a very specific method of drawing aimed at developing and representing an architectural project, one which is used in two very well defined areas. One is objective drawing, of a scientific nature, necessary for describing, and making understandable for others, those forms that only exist in the mind of the designer. It is based on the systems of representation and assisted by the rigour of geometry to define the shapes and dimensions of the architecture. The other is sketching, that is to say, a drawing used as a guide for architects, helping them in their search for architectural solutions. It is present in the composition and formal development of a project's concept. Unlike the first area, which aspires to objectivity, a sketch is subjective, personal and very flexible in its graphic possibilities. It basically uses freehand expression with many drawing techniques, although computers are now being ever more frequently used, with the possibilities that this offers for searching and creating in the project phase. These two architectural drawing methods have been described in the order of importance they are ascribed in architectural education,

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and even in the order in which the student learns them: First the geometry and the systems of representation characteristic to objective drawing, and then, with much less protagonism, sketching and subjective drawing. This imbalance is currently greatly in favour of the first method, due to the highly attractive nature of computer graphics in viewing the project, representing as it does a spectacular avant-garde technology, resulting in much effort being dedicated to it.

While admitting the validity, necessity and interest of these two areas of architectural drawing, both indisputable in architectural practice, we can, however, ask ourselves about another method of expression: What is the real drawing method of the architect, that which can accompany them all their lives, independently of the evolution of the technical means and the materials available, the method to which they can have recourse in many different situations, which can be used in the project phase, but also prior to that, i.e., in their own education? The answer to this question leads us to incorporate a third concept: Drawing to learn, to understand architecture and the reality that surrounds us. It is a drawing method that is necessary and essential in architectural education, one which, by its very nature, is independent of the other two, described above. It is a drawing method that is not subject to the demands of clarity or rigour, not even objectivity; it is drawing that has no particular aim; it is done simply for the pleasure of drawing and springs from the love of architecture and of the place where it is. Through the fact of its execution, it opens up the object observed from the natural to admiration and it allows us to remember those things that we have seen and the emotions we have experienced. We are speaking of drawing architects do in their own formation, drawings made on journeys and any notes made for understanding architecture (Fig. 1).

It can be stated that, with the incorporation of this last concept, the three methods of drawing described up to this point should be considered as fundamental in architectural education and practice. The first, scientific drawing, is used for rigorous representation; the second, subjective drawing, to create and develop forms; while finally, the third, freehand drawing, is used to maintain a dialogue with the visible world and constructed architecture, and to learn from them.

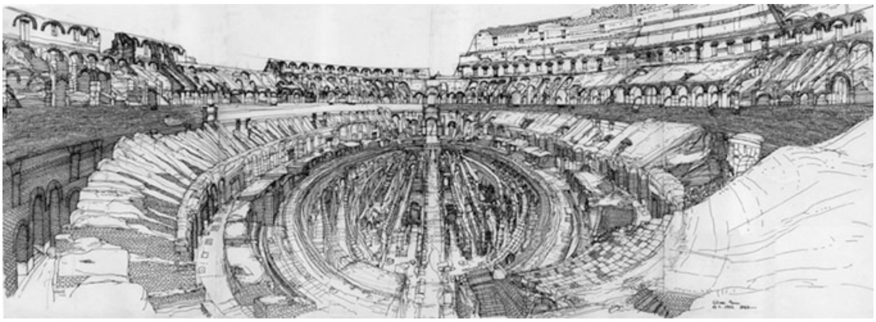

Fig. 1 Juan M. Báez Mezquita, interior perspective of the Colosseum of Rome, 1993

The use of drawing to "learn from everything" has been used by architects throughout history, generating a stream of accumulated information over the centuries, which requires our attention in order to see what the interests of the authors were, their chosen motives, the method of graphic representation and the techniques and support used. Travel drawings are a logical consequence of the learning vocation, as its principal objective is to graphically represent, recreate and memorize historical architectural models, the destiny of architects' educational wanderings. It usually produces subjective images, created for the author's personal use, which have no intrinsic interest beyond their private use (Fig. 2).

A particular group of travel drawings is made up of images drawn in situ, during a study trip, by the author in order to learn about the architecture represented, but which ends up having a much wider purpose: To serve as a support for transmitting the architectural values to others. The drawings, on these occasions, are subject to even greater demands than those proper to the journey itself, as they must combine subjectivity, present in every personal view of architecture, with a degree of objectivity that makes them comprehensible and didactic for other observers. They should contain the characteristic values of the architecture they are depicting, using the most adequate systems of representation for the objects in question, showing the best images and points of view. To draw in this way, a prior architectural culture is needed that allows the most convenient images of the buildings under study to be chosen; a culture that feeds off new information obtained during the creation process itself.

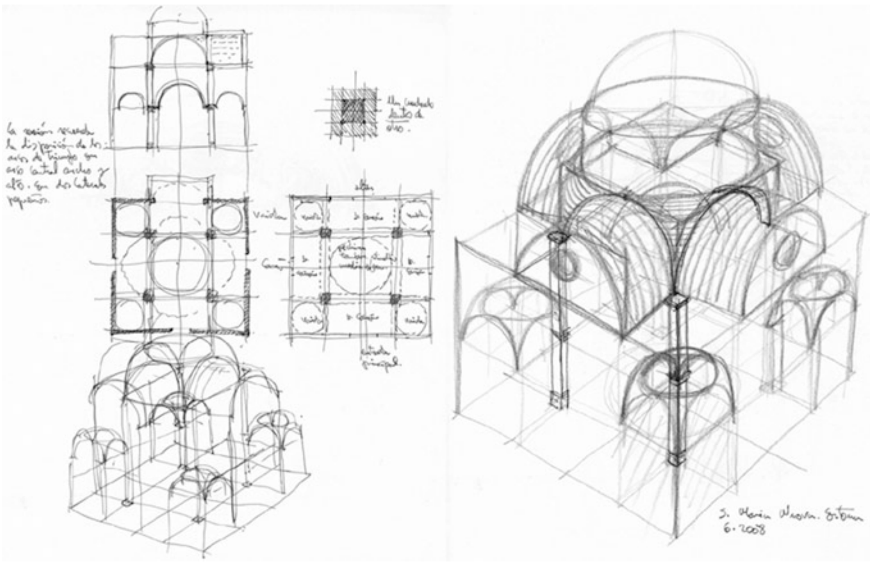

Fig. 2 Juan M. Báez Mezquita, sketches of the ground plan, section and perspective of the church of Santa Maria Nuova, Cortona, 2008

I shall now illustrate this kind of travel drawing using the results of a concrete experience: The drawings I did of the Greek Doric temples conserved in the archaeological enclave of Paestum (Italy) during a four-month stay. The drawings made in situ are objectively travel drawings, arising for the author's own formation. The author wishes to know, understand and memorize the architectural characteristics through the hours of observation and analysis needed to draw any structure. Yet, at the same time, there is a desire to go beyond this, hoping that the images obtained will clearly express the compositional values of the temples and, by extension, of the Greek Doric order. Such an approach supposes a reflection on the architecture in question, prior knowledge of it implying prior study of the documental sources before the visit to the archaeological enclave. How other authors have drawn these works should also be studied, but also how their characteristics are analysed in the theoretical texts. This information, together with the careful observation of reality, should allow us to determine the best way to represent the temples with respect to their own intrinsic values, inevitably subject to the artist's own personality.

Traditionally, in the drawing of classical ruins, in which architectural orders are relevant, ground and elevation plans of the various architectural structures as a whole or in parts have been done. In fact, the most characteristic way to represent the orders in treatises is with the elevation of the set made up of a capital and part of the shaft of the column, the entablature and the cornice. Planimetric elevations generally avoid the current state and reconstruct the architecture ideally in its original perfection. At other times, it is true, the ruin, the broken and abandoned architecture, has drawn the attention of travelling artists to make representations in perspective, sometimes fascinated by the plasticity and other times, more commonly, interested in showing the appearance of the structures as they appear to their eyes, in their real state of conservation. Both options coexist in the graphic memory of Paestum, in how its temples have been seen and drawn over the last few centuries. There are representations of ground plans, elevations and sections, such as those in the book by Paulantonio Paoli, and highly rigorous drawing up following the directives of the Academy of *Beaux-Arts*, such as those of Henry Labrouste, which take great care with the dimensions, the architectural type, and the hypothetical reconstruction; others, such as Giovanbattista Piranesi, decided on the natural view, concentrating on the aspect of the building at that particular moment in time, incorporating what surrounds it. These are antagonistic views but they complement each other: One looks for the timeless nature of architecture, represented outside of time; the other stops time at an instant in a view that traps the unique, unrepeatable moment of the artist's observation.

In the architecture of Paestum, as with many others, there is a very evident gap between the multiview representation, of an abstract nature, and the appearance with which human observation perceives them. Goethe (2001, 240) noted in the diary of his visit: "In an architectural plan, these ruins seem more elegant than they really are, while on the other hand, presented in perspective, they seem heavier: Only when we walk around them and in among them do they communicate to us their true life, only then do we feel that life emanates from them again; such was the architect's intention". From these words, it would seem that the German author had perceived that the temples are more elegant in their elevation, one could even say lighter, since a great part of their mass cannot be seen, such as the columns, of which, as they are lined up one after the other, only the first is visible; the capitals also, whose profile alone is offered by the elevation, as the circles they are made up of become straight, horizontal lines. The view in perspective, on the other hand, considerably increases the weight and the accumulation of mass, since here the other columns are visible behind the first ones. However, where the weight of the mass is especially evident is in the capitals; here the circular lines of the echinus, as well as the diverse decorative lines, are seen as very open ellipses of varying widths situated at different heights; in addition, the very low point of view means that the inferior forms overlap with the superior ones, increasing the solid effect of the whole.

The architects themselves paid close attention to the visual perception of these masses of stone and to their accumulation, and when they considered it opportune, they made corrections in the proportions and compositional alterations in agreement with the empirical experience of their real perception of these works. This is something that, as is well known, is characteristic of the Greek Doric order and, logically, is also found in the temples of Paestum, where the observer's real vision influenced the constructed forms.

In my case, in my experience as an artist in the archaeological enclave of Paestum, I decided to draw the architecture exactly as I saw it, to recount reality exactly as it was presented before me, using the view of perspective as the means of representation. The drawing has dwelt on the view provided by the human eye, a view which does not fully coincide with the conic perspective, being much richer and more flexible (Fig. 3).

The decision to draw using natural perspective sprang from these theoretical suppositions and it is the first premise of the collection of drawings done at the archaeological site. Drawing in this way implies a link between the observer and the represented scene, as, unlike in the Planimetric elevations, where the position of the observer does not exist, in a drawing done with perspective, the distance of the

Fig. 3 Juan M. Báez Mezquita, exterior perspective of the temple of Poseidon at Paestum, 2010

artist from the temple can be intuitively approximated with a fair amount of accuracy, as well as his/her location to the left or right of the model. The spatial situation of the point of view is explicit in the way in which the architecture is shown; situating oneself in one position or another alters the perception of the architecture precisely because it incorporates one's own subjectivity of the unique view. This obliges the artist to choose very carefully the place from which to observe the architecture, eliminating the other infinite number of possibilities offered by the surroundings. Thus, the choice of the point of view becomes a fundamental aspect of the artist's work, perhaps even the most important, if we consider that all later decisions are conditioned by this first one (Fig. 4).

In my collection of drawings, the three temples of Paestum keep appearing, as I wanted to tell, through different images, what would only be partially and insufficiently shown through a single image. I made several drawings of each building from different points of view in order to capture the different aspects of the architecture; thus, each one completes the rest and the architectural concept emerges from the complete set. Nevertheless, each drawing has its own independence and possesses its own reading, while together, united in one collection, they mutually complement and enrich each other, generating a polyhedral vision of the reality.

One is aware that the choice of the point of observation to draw from, as well as its framing, can greatly change the perception of the architecture, pulling the image towards a subjectivity inherent to all graphic representation, since one can choose to draw a view of the whole or, on the contrary, a partial image, or one can decide to focus on the diverse architectural details. In addition, the artist's relative position, near to or far from the building, can exaggerate the effect of perspective or cancel it out to such a point as being hardly perceivable in the image. These decisions speak

Fig. 4 Juan M. Báez Mezquita, interior of the temple known as The Basilica of Paestum, 2010

to us of the artist, his/her aesthetic approach, his/her architectural and graphic culture, which help him/her in the choice of the most suitable instruments for the architectural concepts that have shaped these buildings and how the artist finally wished to express them.

In this graphic study, I decided to work solely with the three Greek temples still existing in Paestum for their relatively good state of conservation and the architectural unity they present. Built during the 6th century BC, their architectural language and aesthetic ideal are similar, although the span of time over which they were built is also sufficient for there to be profound differences of style in their final materialization, with more archaic elements in the Basilica and the temple of Ceres, and more evolved elements in that of Neptune. Drawing, the act of drawing, allows similarities and differences to be identified and converts the archaeological area into an ideal place to study the Greek Doric order, or at least how it was materialized in this far off colony, where it acquired very different architectural forms from those used in the cities of the Greek continental zone. I proceeded in a similar way in all three temples, looking for similar points of view that show common characteristics, but which also show up their differences.

The Greek Doric temples are viewed diagonally and it is on the corner where their maximum expressiveness is to be found, since the identity of the elements used in the diverse facades needs an adequate articulation at this point. The repetition of the columns of the peristyle, the frieze with its alternating triglyphs and metopes that are uninterrupted by the corner, and the cornice with its accumulation of small details, all contribute to enabling the facades to be read architecturally as a continuity of elements, as if the very pieces of the elevation had turned ninety degrees to continue their development on the other side. An evaluation of the architecture in accordance with these parameters invites the creation of decidedly oblique panoramic drawings showing two facades and their concurrence at the corner (Fig. 5).

The front view is not perhaps the most characteristic of this type of architecture, yet such a drawing allows the disposition of the elements of the architectural order to be shown clearly. In addition, the building in ruins, having lost its roof, allows us

Fig. 5 Juan M. Báez Mezquita, oblique view of the temple of Neptune at Paestum, 2010

to see the foreshortening of the elements farthest away through the columns, creating a confrontation between the front view and the perspective (Fig. 6).

The study of the capitals is especially revealing in understanding the architecture of these buildings. Those of the Basilica and the temple of Ceres are very similar to each other, while those of the temple of Neptune present very different forms, much closer to those of the refined temples of continental Greece, such as the Parthenon, with the gorgerin and the three deeply sculpted clefts that mark the end of the shaft, with the profile of the more pronounced and slenderer echinus than in the other two.

The execution of these drawings has three well defined phases, each one different, each with diverse missions, but finally complementary for the final result:

1. The pencil. The first lines are made using a coloured pencil, in this case of a reddish tinge, instead of the graphite lead, which can be smudged more easily.

Fig. 6 Juan M. Báez Mezquita, western facade of the temple of Neptune at Paestum, 2010

The colouring is used so that the diverse strokes can be incorporated into the expression of the final work, even in the cases where they can occur in excess. The pencil is soft and is used with a rounded point, unsharpened, which avoids the temptation to make a highly detailed drawing and allows the drawing to be done quickly, as it slides smoothly over the paper. This first phase should be

Fig. 7 Juan M. Báez Mezquita, capital of the Basilica of Paestum, 2010

Fig. 8 Juan M. Báez Mezquita, capital of the temple of Neptune at Paestum, 2010

accurate but concise, without entering into the definition of details, the drawing being constructed, analytical, rigorous, simple and schematic (Figs. 7 and 8).

This stage resolves the problems of proportions and the geometry inherent to the model, as well as the perspective, which is built up by tracing all the necessary auxiliary lines, which will not be erased and which will remain in a latent form, even in the finished drawing. This phase is a preparation for the next, drawing with the pen, and as such should resolve the problems of composition and facilitate the way without going into details that the ink lines will provide. Its execution obeys the axiom of "not drawing the same thing twice"; that which the pen will define should not be drawn in pencil, and vice versa, the pencil will draw auxiliary and geometrical lines that the pen needs but will not draw (Fig. 9).

2. The pen. The pen drawing is done with a dip pen and hazelnut coloured Winsor and Newton ink, a tonality that is in harmony with the pencil base and with the colouring of the models themselves, which the watercolours accentuate. The pen defines the form in an exact way, with its mouldings, thicknesses, pieces, textures, fractures, stains, etc. This results in an accurate drawing, attentive to everything that makes up part of the scene, including the surrounding countryside with its vegetation. It is a cold and objective means of representation, where the comprehension and definition of the diverse parts becomes essential. The final result is overwhelming because of the great number of lines that, in some areas, can make their correct interpretation difficult, but which the following phase in watercolours will finally place in their right measure (Fig. 10).
3. The watercolours. These provide the elements' local colour, especially that of the stone, with the subtly changing surface colours that are the result of the remains of the original polychrome, the colour of the stone itself and the alterations this undergoes due to the atmospheric agents over the centuries. This is the moment to incorporate the chiaroscuro, with the changing effects that the movement of the sun produces; light and shade that are essential for the Doric architecture to fully show the subtleties of colour and whose range illuminates

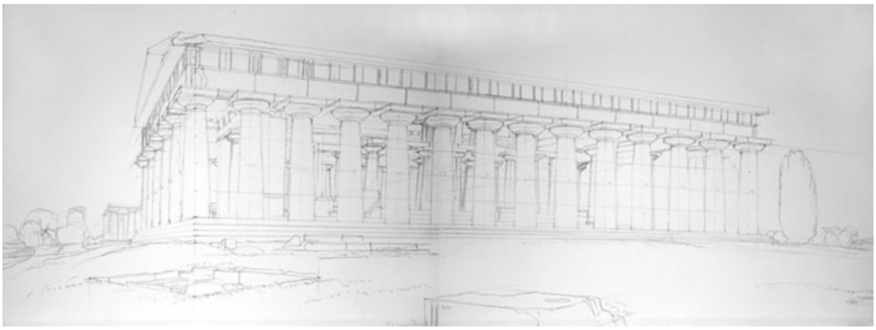

Fig. 9 Juan M. Báez Mezquita, pencil stage of the drawing of Fig. 5, 2010, of the temple of Neptune at Paestum

Fig. 10 Juan M. Báez Mezquita, pen stage of the drawing of Fig. 5, 2010, of the temple of Neptune at Paestum

the extremely fine lines that the working of the stone has left on the entablature and the peristyle.

The vegetal elements surrounding the temple are also incorporated at this stage, drawing them with great care and attention, especially the many varieties of tree, which introduce subtle variations in the greens. The sky, which appears totally white in the ink drawing, takes on life through the watercolours, creating space and colour for the representation.

The drawings thus achieved show the architecture from the point of view of the observer who contemplates it, walks around it and visualises it just as its authors conceived it; they show the validity of the perspective as a means to document the architecture, since they offer information that the Planimetric elevations cannot achieve, because, in addition to offering more precise proportions, they relate the diverse elements of the building to each other, as well as relating the architecture to its surroundings, to the landscape or to the immediate environs. They also record the state of conservation, the passage of time, the ruin of the building, the result of the aggressions that the temples have suffered over the centuries.

These drawings demonstrate the wide-ranging concept of architectural elevation, which is not limited exclusively to Planimetric ones, but which is determined by the author's intention, his/her vocation for documenting architecture, giving rise to what could be called "perspective elevation".

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Author Biography

Juan Manuel Báez Mezquita Doctor & Architect. Full Lecturer in Graphic Architectural Expression at the 'Universidad de Valladolid' (Spain). Professor of drawing at the 'Universidade Lusíada de Porto' (Portugal) for twelve years (1994–2006). Guest Lecturer at the 'Universidad Experimental de Táchira', San Cristóbal (Venezuela), at the *Università degli Studi di Napoli Federico II*, Naples (Italy) and at the *Università degli Studi di Salerno* (Italy). Developed research lines: (1). Popular architecture, types and rural ensembles. (2). The drawings of Renaissance architecture. (3). Drawings of architects' travels, combined with personal experiences in drawing and painting the landscape and architecture. He is the author of several articles on drawing and the analysis of architecture in specialised journals. He has participated in International Congresses in Spain, Portugal and Italy, and he has given conferences, doctoral courses and masters in several universities both inside and outside Spain. He is the author of the following books:—1992. *Arquitectura Popular de Castilla y León, Bases para un estudio*, Valladolid.—1994. *Arquitectura popular de Sanabria. Asentamientos, morfologías y tipologías rurales*, Zamora.—1994. *La piedra en Castilla y León*, Valladolid.—1998, *La memoria de la arquitectura. Dibujos de viajes a Italia*, Valladolid.—2000. *La casa tradicional en las Tierras de Alba y Aliste*, Zamora.—2001. *La piedra en Castilla y León 2001*, Valladolid.—2006. *Construir en piedra*, Madrid.—2008. *Espacios, Acuarelas*, Valladolid. Since 1976, he has regularly exhibited his own drawings, paintings and photographs. www.baezmezquita.com.

Analysis of the Plan for the Study of the Historic City. Methodological Transfers Between Architecture and Archeology

Mercedes Díaz Garrido

Abstract This paper deals with the study of the historic city through the plot plan as a source of knowledge. Methodological issues are tackled in their relation to two different yet linked concepts, morphology and stratigraphy, with the purpose of setting the basis for each and their respective links to the areas of architecture and archeology as disciplines, and a proposal is made for the application of both concepts to the analysis of the plan. At the background lies the reflection on drawing in investigation and on the need for multidisciplinary outlooks.

Keywords Historic city · Urban morphology · Urban stratigraphy

This paper reviews the concepts and the theoretical principles upon which the analysis of the plan of the historic city, particularly of the plot plan, as a source of knowledge, could be based. This idea arises as a research on the church of Santa Maria in Carmona is in progress.[1] Due to the importance of this building and to its influence on the development of the city, the project has an urban-scale approach in order to establish the relation architecture—city along the different stages of their growth and transformation. The complexity of the plan of Carmona, which is the outcome of a continuous settlement from antiquity, has given rise to the theoretical reflection here put forward around the nature of the historic city as construction, as well as around the urban shape and its analysis.

The paper consists of two sections:

In the first, two linked and complementary concepts are reviewed: *morphology*, as used in urban analysis, and *stratigraphy*, as used in archeology of architecture. Both are related to a certain understanding of the nature of the object of study—city

[1]Project I+D+I "Seville Cathedral Gothic: Architecture and city in the spheres of influence of the Cathedral of Seville", Ref.: HAR2012-35152.

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and building respectively—, and the method adopted by each for the form analysis is considered.

In the second, a proposal is made for a synthesis of both concepts, directed at the analysis of the historic city which is regarded as a simultaneously organic and stratified construction. A method is sketched for the analysis of the urban shape using the plot plan as a basic document. In this method is implicit the primary role of drawing as a means and a tool for documentation, analysis and spread of the results.

1 Morphology and Urban Analysis

The term morphology is to be found in texts on urban analysis as a synonym for urban shape, generally used in relation to typology. Whereas the last, as well as the concept of type, are studied and precisely defined, this is not the case with the first. Let us see what we understand by morphology and in what ways this concept is used in urban analysis.

Morphology is a term used in different branches of knowledge, from linguistics through geology to biology among others, meaning the study of the shape and structure of something, especially of an organism. In every instance it refers to the study of the shape in relation to the logic of its shaping. The study of the shape is thus understood as a reading of the process of its shaping by means of identifying the patterns and the rules or laws which have determined it.[2]

The relations typology—morphology and building type—urban shape were emphasized by urban analysis, but it is in Caniggia that we find a more thorough development understanding the urban shape as really connected to the concept of morphology, even if the author does not use this term. His book *Lettura dell'edilizia di base* (Caniggia and Maffei [1979] 1995) is a wide exposition of his approach, which can be summarized in the following issues:

- The *city as a historic organism*, this organicity meaning an identity as well as a kind of structured order, with the presence of elements and relations at different levels.
- The structure as the result of the process of shaping, hence the *identity history—structure*.
- *Analysis as a reading*, as a reconstruction of the process which can be recognized in the structure itself.

[2]The term was introduced by Goethe in his studies on the form of the plants as "Morphologie" from the old Greek "morphé" (form) and "logia" (treatise). It already expressed its two defining ideas: the existence of typical, archetypical or primitive forms, and evolutionary process which is subject to patterns of formation and transformation.

– The process as dominated by the existence of elemental patterns and schemas which are common to the same cultural context. This is called *typological process*.
– *Progressive levels of organization* of the urban organism, belonging to different scales of observation and to different times of reading.

The idea of typological process leads to *comparison* as a method, an issue that can be found in further texts by the same author. Thus, it is Caniggia's purpose to identify and typify the processes, through a comparative study of similar examples, within a precise cultural background: "(…) we can isolate behaviors that are typified, codified and therefore recognizable to us, within a spatial and temporal interval, and at the same time we can also verify the organic, coinciding diversification of those behaviors as that interval changes. So we will be able to reconstruct a series of typological processes that will connect analogous objects from different periods of time" (Caniggia [1974] 1997, 30).

The interest for typological processes leads simultaneously to a requirement for evolutionary continuity of the urban area under inspection, as is shown in his article "Lettura delle preesistenze antiche nei tessuti urbani medievali" (Caniggia [1974] 1997). Here the author refers to urban analysis as an archeological method for the study of the historic city in the following terms: "It is our purpose to examine within what limits, and with what probability of success, it could be possible to deduct the structures of an ancient city if its place is occupied by a modern aggregate, reading in the last its characteristics with a systematicity comparable to the one which can be obtained from other methods, that is with a theoretical and technical formulation which warrants enough objectivity; as long as some essential conditions are satisfied: the transition from the old to the new aggregate should have taken place through a gradual transformation, not by means of a traumatic, sudden substitution, and without being abandoned for too long" (ibid, 27) (Fig. 1).

But as refers to a thorough study of an urban organism, especially when its complexity is increased by its age, the difficulty lies in identifying the different processes along its evolution and in finding relations among them. It is to this purpose that we introduce the concept of stratigraphy.

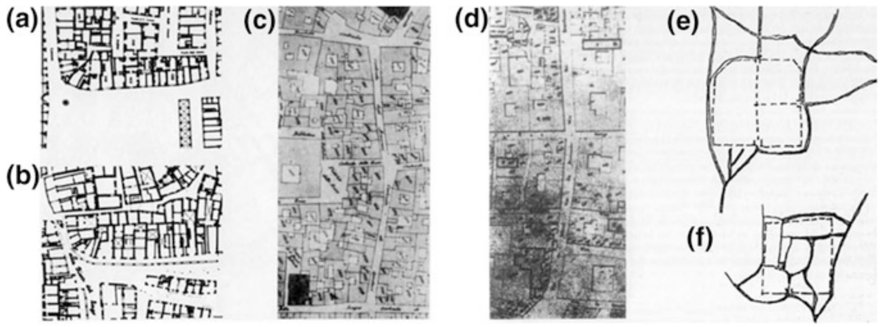

Fig. 1 Caniggia. Similar middle-age transformations in analogous ancient structures

2 Stratigraphy as an Archeological Method

Stratigraphy is originally a geological method used for the study of the processes that gave birth to the formations in Earth. It starts from the conception of these formations as stratified and of the historical character of stratification, as wells as from the existence of a number of laws which determine its shaping. It takes into account the layers or levels which can be recognized, along with the interfaces or discontinuities between them, both being the outcome of periods of time, whether of sedimentation or of interruption and erosion of the deposit. Given its cumulative, nature-originated, relatively simple character, a few principles or laws would allow the recognition of the relative sequence of layers from its spatial situation. These are the laws of *superposition*, of *original horizontality* and of *original continuity*.

Owing to its origin in geology, stratigraphy is the object of a specific development in archeology, where it became established with the method proposed by Edward Harris in the 1970s (Harris [1979] 1991). It is then that the principles of *archeological stratigraphy* are defined, from those principles a system of register known as Matrix Harris is developed in which the stratigraphic sequence is pictured as a diagram. This method can be put into practice in an archeological site, where the natural conditions of stratification are altered by human activity.

In this case, the principles or laws of archeological stratigraphy would influence the physical disposition of the archeological stratification, enabling the archeologist to determine the relative chronological order in which the stratification was created. But, in contrast to the linear cumulative character of geological stratification, most archeological sites show multilinear stratigraphic sequences. Taking this into consideration, Harris introduces a new law in addition to the laws of geological stratigraphy which are suitably adapted. This is called by him the law of *stratigraphic succession*; it refers to the way every stratigraphic unity is shown within the sequence as depicted through its own diagram, the Matrix Harris, so that superfluous relations are eliminated. Thus, "Matrix Harris provides archeology with a method which enables the diagrammatic expression of stratigraphic sequences in a very simple way" (ibid, 58) (Fig. 2).

From urban archeology, discipline where it was born, the stratigraphic method as proposed by Harris reaches the archeology of architecture, where it will undergo a new specific development toward what is known as *stratigraphic method for the reading of faces or stratigraphic analysis of historic buildings* (Caballero Zoreda 1995, 38). This method means understanding the building as a historic construction and its use for the reading of façades, regarding these as stratigraphy. Its birth takes place coinciding with the development of middle-age archeology in Italy, with the contribution of such architects as Roberto Parenti or Gian Pietro Brogiolo.

In the definition of the stratigraphic unities as well as of their relations, stratigraphic and architectonic concepts are used. Both are defined after their characteristics: material continuity and differentiation, but also after the constructive action which brought them forth. The criteria for their identification should be not only stratigraphic but also constructive and formal, and they require that the

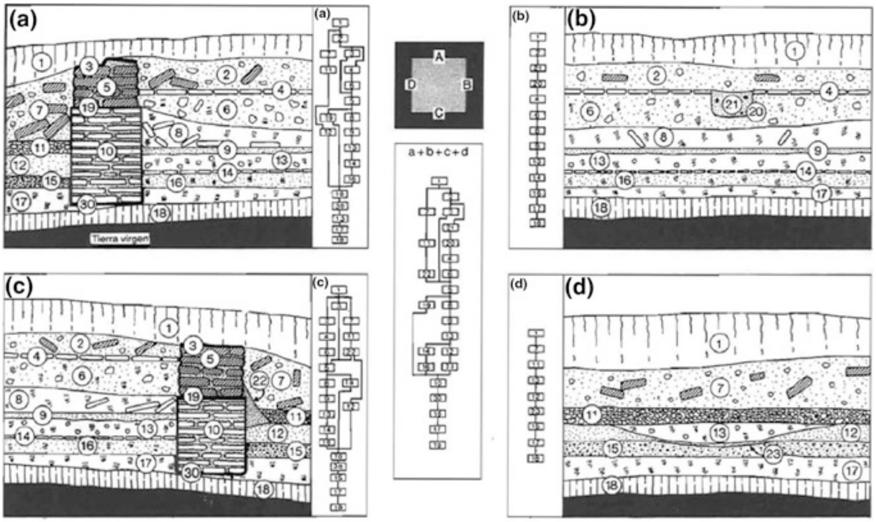

FIGURA 21. Esta ilustración, junto con la siguiente, muestra la construcción gradual de una secuencia estratigráfica a través de las secciones representadas en los perfiles A-D. Según la ley de sucesión estratigráfica, los cuatro perfiles se han fundido en una sola secuencia (a+b+c+d), habiéndose eliminado todas las relaciones superfluas.

Fig. 2 Harris. Gradual construction of a stratigraphic sequence

constructive techniques and processes, as well as the formal aspects of the building, be known: (Fig. 3)

- The layer, or wall stratigraphic unity, is defined as "the minimal built unity which can be stratigraphically isolated from those surrounding it, and the basic object of study—a fragment of a wall or of a window, a putlog hole, a piece of a slab, a filling…—" (Caballero Zoreda 1995, 39).
- With respect to the interface or surface: "As in elements, three aspects can be distinguished in surfaces, the first being genetic, or constructive activity, which gave birth to its geometrical appearance or shape, the last having a temporal value. Geometrically, it is defined as the limits or surfaces of the elements divided by it" (ibid, 40).
- The relations between stratigraphic elements are defined as stratigraphic-constructive: "The analysis of the stratigraphic-constructive relations is doubtlessly the most delicate stage of the process. Three different readings come together in it: the reading of the spatial situation of the elements—in contact or not, above, underneath, alongside—which is associated with the reading of the constructive action that created them—covering, filling, leaning, placing aside, cutting, joining, etc.—and which ends with a temporal sequence—simultaneity, priority or posterity—" (ibid, 43).

As the constructive process is different, more complex than in the accumulation of an archeological site, the stratigraphic sequence cannot be deduced so straightforwardly from the spatial situation of the elements; it should be expressed in terms

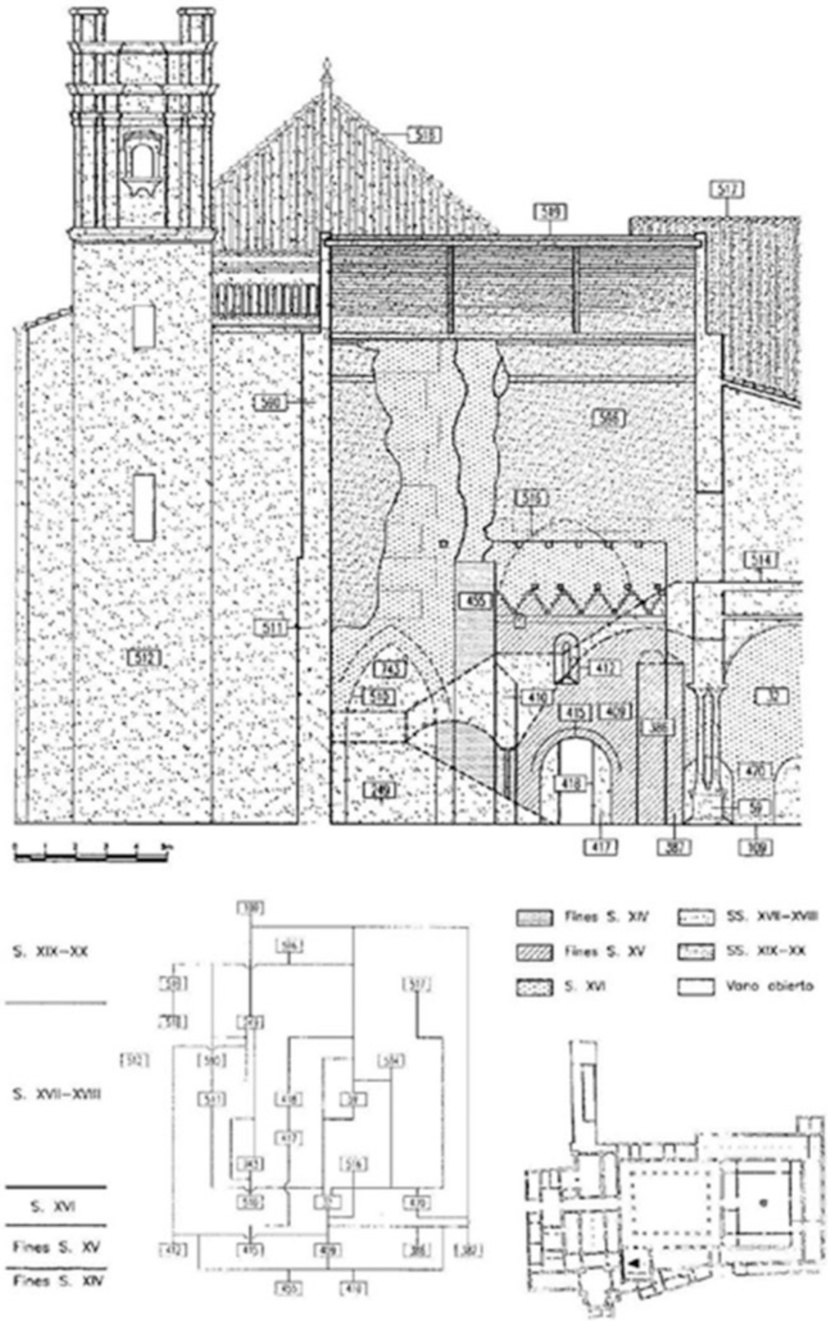

Fig. 3 Reading of faces. Miguel Ángel Tabales. Carmen Headquarters, Seville

of constructive process. Its formal aspects would also mean a further factor of complexity. The adoption of the very laws or principles of archeological stratigraphy, even if adapted and expanded, and through it of geological stratigraphy, seems somewhat unnatural. Indeed they are no longer mentioned as laws but as principles, or even more imprecisely as phenomena: of *superposition*, *succession and continuity*; of *original horizontality and lateral continuity*; of *cross or cut relations*; of the *temporal discontinuity and of the greater importance of hiatus in the stratigraphic record*.

As for the method used, it consists of the development of a number of stages:

– *Graphic documentation and observation*. A fundamental stage, since "to document, as a synonym for reading a document, somehow means in the analysis of historic buildings the same as excavation in a site".
– *Distinction of elements and their record in analytic files*. Distinct elements and interfaces are analyzed by means of files where they, as well as the actions since their creation and their relations to the rest, are described.
– *Diagram or matrix of relations*. It depicts the temporal sequence, where the elements are chronologically ordered after their relations of diachrony in vertical columns and of synchrony in horizontal rows. Diagrams are first built in files, element by element, and are thereafter assembled to produce the area diagrams.

Far from being a literal application, the method of face reading means a rather free interpretation of the stratigraphic method, made unique by some characteristics. First, because it involves the integration of two disciplines, archeology and architecture, that take part in its definition. Second, because of the possibility of using a method conceived in the field of excavation for the analysis of a built reality in its apparent conformation, in this case through its façade. These are the characteristics that we intend to bring to the study of the city, and the reason why we speak of the plan as stratigraphy in the following section.

3 The Plot Plan as Stratigraphy

What follows might be considered a sketch of a *stratigraphic-morphological method for the analysis of the plot plan of the historic city* which makes a parallel use of notions derived from both concepts. This method points to a global analysis through the plan, understanding this as the result of an evolution in which morphological and stratigraphic processes participate. The morphological analysis would provide the theoretical basis from which the city could be considered as construction. The stratigraphic method would provide the systematization and, in spite of being an archeological method, a certain possibility of abstraction of the object, of dealing with some moments of the analysis from perceptive criteria based on the formal characteristics of the stratification.

4 Historic City as Stratified Construction

Quoting Rossi ([1966] 1992, 60), we understand the city as architecture, as collective construction in time, and here we would add: as stratified construction.

When we speak of construction of the city we do not refer to material construction but to conformation, so that the concept of *urban shape* would best match the idea of *city as construction*. We speak of a structured shape, understanding the city as an organism composed of two kinds of elements, the primary elements and the residential area. The primary elements would be those that direct or guide the growth—elements of the site such as the territorial pathways, built elements such as ramparts or delimitations, urban scale pathways, places or singular buildings—. The residential area is the extension, the most of the construction of the city, and as urban analysis has shown its construction is determined by the building type and by its way of aggregation as it makes up the urban tissue.[3]

But the city as a whole, especially as concerns cities with a long history, is the product of the superposition of different moments in its construction, of different structures, that can follow several ways of spatial relation to the previous ones: coincidence, juxtaposition, superposition…. This is why we speak of stratified construction or, similarly, of stratified urban shape.

5 Plot Plan as Stratigraphy of the Historic City

It is well known that the plan is the graphic document by means of which we perceive the whole urban shape in the reach of its growth, in its extension. Thence we speak of the plan, in particular the plot plan, as stratigraphy and of its possible stratigraphic-morphological analysis.

The plot plan best reflects the character of the city as construction for some reasons. First, the plot is an element which usually remains, contrary to the renovation of buildings. It is also the connecting element between building type and tissue, reflecting the features of the type which have to do with its way of aggregation. Finally, thanks to the commonly seriated, modulated character of the tissue it is sometimes possible to recompose the original plotting schema as it was at the time of its birth. The plot is therefore an essential element for distinguishing tissues and recognizing its original shape.

6 Goals of the Analysis and Stages of the Work

The purpose of the stratigraphic analysis of the plan would be to identify, characterize and typify, if possible, the different actual structures in their relation to different times of shaping, as well as to determine the temporal sequence as it can be

[3] "Primary elements and the concept of area" (Rossi [1966] 1992, 111–185).

deduced from the spatial relations between structures. The analysis of the plan thus carried out provides an amount of data that can be considered in order to establish the process of urban conformation even though they must be contrasted with the data from historical or archeological sources.

A draft of the work stages is proposed which is similar to that used in the reading of faces, with some differences. Stages: documentation and observation, identification of structures and relations, establishment of the temporal sequence, plus a stage of synthesis (our addition). We will make some remarks which imply the basic importance of drawing as a means and as a tool:

– *Documentation and observation.*

Since we mean to read the shaping process, the plan for the analysis must be a reliable plot plan, as old as is allowed by the existing historical cartography. Unfortunately, in most cases the first plot plan available were made around 1970—cadastral implantation plans—, after the spread of photogrammetric flights, while the first adequately accurate urban plans—military plans—dating from the late 19th century. In order to make up for the lack of a plot plan antedating the contemporary transformation of the city, the task of reconstituting the historical plan must be undertaken with the inclusion of an approximate plot plan obtained from the elimination of those plots which appear to postdate the reconstituted plan.[4] This reconstitution is done in as many steps as historical plans are used, in a backward sequence.

As reconstitution we understand the redrawing of the historical plan with the present digital plan as a graphic basis. After superimposing the historical plan on the present plan, by means of simple operations of rotation and scaling, we can make element comparisons. This can lead us to a number of actions: eliminating from the present digital plan the elements subsequent to the reconstituted plan, checking those which remain, including from the reconstituted plan the missing elements. The reliability of the process is in proportion to the number of plans in the sequence. At least there should be two plans, beginning with the cadastral implantation plans and ending with the oldest historical plan.

This process represents not only the stage of documentation but also a first stage of analysis and observation. Analysis, because it allows the growth and transformations during the interval of time encompassed by the whole plan series be detected and eliminated. Observation, because simultaneously we get a certain acquaintance with the plan and are able to see differentiated structures in it (Figs. 4 and 5).

– *Identification of structures and relations.*

By this is meant the distinction of formal structures and of relations among them, so that a reading is achieved which is meaningful and coherent, that is, a reading that conveys a logical shaping process.

[4]The term reconstitution is employed following the proposal made by Javier Ortega Vidal in is paper "Drawing and building life", published by EGA, Revista de Expresión Gráfica Arquitectónica, n° 11, Universidad Politécnica de Valencia, 2011.

Figs. 4 and 5 Reconstitution of the historical plot plan of Carmona

The structures thus identified will be defined by the selection of some elements present in the plan—pathways, plots, arrangement of streets, blocks…—They will also belong to a fragment of the urban shape, related to a given time in the construction of the city. The reading or interpretation of these will consist of its formal description or characterization and of its classification or adscription to a type of urbanism if possible.

The spatial and formal relations between structures—coincidence, juxtaposition, superposition, hierarchy…—can be read as temporal relation—continuity, growth, transformation…— (Fig. 6).

– *Establishment of the temporal sequence.*

The establishment of the complete temporal sequence as a reading of the shaping process would derive from the total spatial structures and relations detected.

In this stage as in the previous, the reading is never self-evident, mainly in the cities with a more complex stratigraphy, requiring now a progressive, now a trial and error approach. Drawing the plan is essential in this process as a way of visualizing and checking (Fig. 7).

– *Synthesis.*

The reading which has been obtained from the stratigraphic analysis of the plan should be coherent with the data provided by other sources, with which it must be contrasted in what we understand as a synthesis. Nevertheless, the method should not lose its autonomy as a source of knowledge for the urban history of the city, being conditioned a priori by no other hypothesis. It is thus possible that the contradictions to other data prevent the analysis from reaching clear conclusions, but it may also enable questions to be raised that should be answered as an equally important progress of knowledge.

Drawing plays here too a main role as a kind of graphic synthesis in the possible elaboration of the hypothetic sequence of urban conformation.

Fig. 6 Identification of structures

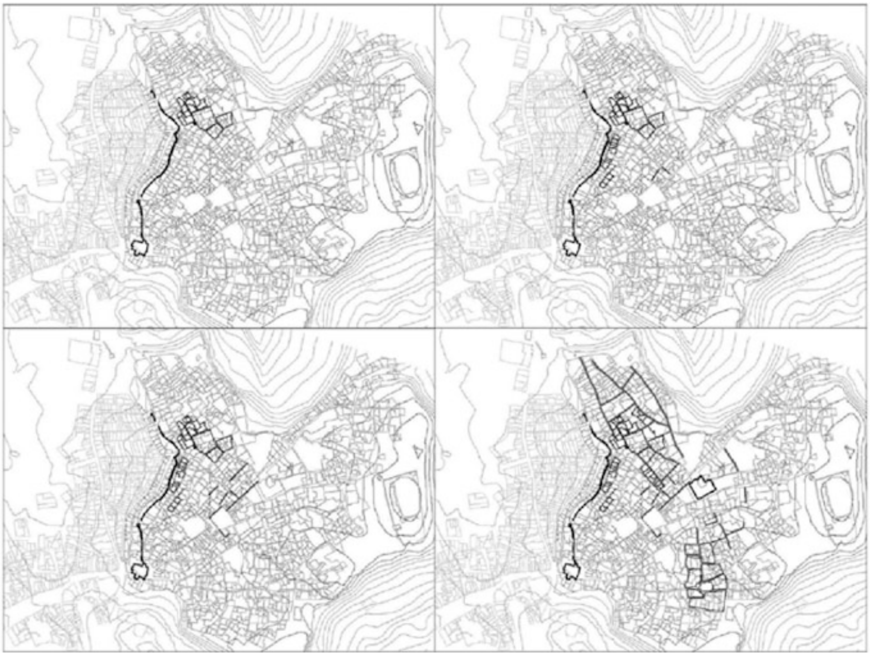

Fig. 7 Temporal sequence of identified structures

Fig. 8 Analysis of the area surrounding the church of Santa Maria

7 Scales or Levels of Analysis

The plot being the essential element for the analysis, the scale of this should be that of the historic area or of a distinguishable part of it. It is nonetheless necessary to have in mind a larger scale or level, in whose shape the elements of geographical location as well as those primary elements related to the creation of the site or the first occupation take part. In the same way, the study of a fragment should be related to a reading of the whole. This has to do with the organic nature of the city and with the *levels of progressive organization* of the urban shape as they are called by Caniggia (Fig. 8).

As we said before, the work on the historic area of Carmona has led to a reflection on the concepts and the method to be followed. In this case we have been able to verify that theory and practice walk hand in hand and progress together. The work is in an advanced stage and will be shortly published as the proceedings to the conference to be held in the city with the purpose of making known the result of the research project.

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From Archival Drawings to 3D Representations. A Case Study of Gabriele d'Annunzio's Birthplace in Pescara

Pasquale Tunzi

Abstract Recently the need to study a group of design drawings, made between 1920 and 1934 by two professionals Italian to intervene on the birthplace of Gabriele d'Annunzio, highlighted the need to make popular this knowledge, also because of the reputation of the owner. Studying the archive drawings means tracing the creative and consequently 'translating' a series of signs and codes in another type of figuration more explained and understandable. Today, the latter, is necessary to be able to communicate in a broad way a certain type of study, and then implements a form of interpretation that allows its transfiguration.

Keywords Drawing archival · Representation · D'annunzio

The analysis of a historical building, in all of its many aspects, is a rather frequent process of study in the academic environment. It focuses on understanding specific characteristics related to both a cultural and an environmental context.

A recent study dedicated to the birthplace of Gabriele d'Annunzio in Pescara (Tunzi 2014), undertaken by two recognised Italian professionals interested in its restoration and focused in particular on drawings of the poet's home realised between 1921 and 1934, revealed the need to disseminate this important and unique body of information.[1]

In specific terms, an archival drawing is a document consisting of one or more technical drawings realised using the geometric model of the Double Orthogonal Projection and conventional norms, in some cases accompanied by pseudo three-dimensional representations, either perspectives or axonometric with an illustrative purpose. The technical drawing, whose prescriptive function as we

[1]This project began in 2009 with the surveying of the historic centre of Pescara, by the Dipartimento di Ingegneria e Geologia, Università degli studi "G. d'Annunzio" di Chieti-Pescara. The Poet's house was among the buildings surveyed, and was also the object of archival research.

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know serves to build what has been designed, contains messages for specialised professionals, while the illustrative material, more aesthetic in nature, is designed to persuade the client in the most immediate and direct manner.

In the field of Architectural Representation the study of archival drawings signifies retracing the creative process and consequently 'translating' a series of signs, figures and codes into another for of representation that is more explanatory and comprehensible. Fundamental to this process is a question of the Hermeneutics of drawing, in other words the interpretation of a historic iconographic text in need of an attentive reading.[2] The translation of an existing image into another visual form must not prejudice its original sense and the result must be similar or equivalent. Obviously it tends to better illustrate the original and to render it more accessible.

Today, the transposition into educational images is necessary to communicate a certain type of study in broad terms, as well as the subject of the study itself, using a form of exegesis that consents a more direct transfiguration.

The interpretation of technical images, specifically the drawings of an architectural project, begins with particular attributions of meaning, whose re-elaboration helps to rediscover and complete the sense of their representation. Digital 3D visualisation helps expose a new value of the subject,[3] rich with data and sensations, which become even more efficacious when they begin to embrace the realm of Virtual Reality.

Those using a computer to develop three-dimensional models are thus involved in the search for a key to reading an existing project that is aligned with the intentions the original draftsman/designer was intent on communicating, as part of a renewed comprehension and narrative dissemination. In this specific case, the process involved an interrelation between drawings (plans, elevations, sections) to obtain a new dynamic representation made possible by 3D digital technologies, in other words, a new visual representation of the projects for d'Annunzio's home.

There are two opposing situations: the original tied to the moment when the drawing was produced, and that of the moment when we observe the same drawing through contemporary eyes, intent on rediscovering and not distorting the original sense of the message it contains. We worked on transferring the intentions of the project, its "occasionality" as Gadamer (1960) would say, into the new representation and, thus on the meaning of this latter product, with a sense of being tied to particular methods and the clarity of the information to be communicated.

Our study examined a selection of drawings illustrating three versions of a project that was never constructed, and which had lain closed in the drawers of an archive for far too long.[4]

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[2]Roberto de Rubertis considers this issue fundamental to the interpretation of the image: Cf. R. de Rubertis, *Problemi di ermeneusi* in *Il disegno dell'architettura*, La NIS, Roma, 1994, p. 119.

[3]Gadamer states that the model is "that which makes something visible, that would otherwise not be visible", H.G. Gadamer, *Verità e metodo*, Bompiani, [1960] 1995, p. 180.

[4]These 93 drawings are conserved in the Archives of the Fondazione Il Vittoriale degli Italiani. Special thanks to the president of the Foundation, Mr Giordano Bruno Guerri for permission to publish. A further 51 drawings, in part duplicates of those mentioned, are held by the Archivio di Stato di Pescara.

Gabriele d'Annunzio wished to honour his mother's memory by renewing the exteriors, and much of the interiors, of the house in which he was born (Di Tizio 1997). He thus commissioned his brother-in-law, the engineer Antonio Liberi, to design a project that would reorganise the interior layout of the house and provide it with the latest comforts. In the summer of 1921, Liberi developed a first version that considered various aspects of the entire building, including a proposal to relocate the front entrance along the corso (Gabriele Manthonè). The plan, elevation and section drawings in pencil on card from 1926 were developed at a scale of 1:50, with details at 1:20 depicting decorative features and formal choices. The first version presents a façade clad in stone, subdivided horizontally into two registers (a high base course with two storeys above) and vertically into three bays: the first to the left with a three-storey loggia. The resulting elevation is both imposing and lavish, with the Renaissance flair appreciated by d'Annunzio.

A second version of the façade was designed in 1929. Its eclectic decoration consisted of two parts: to the left is a two-storey block topped by a terrace, while to the right two pseudo towers bookend a three-storey elevation. We developed a 3D digital drawing of both proposals that highlight the volumes, depths, projections and details, as well as various aspects of the overall design, as per the intentions of their original designer. This approach expands the available knowledge base and offers generic users an improved understanding of what is represented. The technical drawing, in which the recognisability of spaces and volumes is often accessible only to trained professionals, is not always immediately legible. This consideration led to a reflection on the sense of the transposition of the traditional drawing into another, more contemporary form, in other words its "translation" into virtual images with a greater impact. This process, already employed in processes of surveying, translates materials and forms into numbers and then by convention into equivalent signs.

The first two projects were followed by two others that, like their predecessors, remained on paper. These latter versions are the work of the architect of the Vittoriale Gian Carlo Maroni, based on direct indications provided by d'Annunzio himself.[5] The first, from 1933, was designed down to the smallest detail and consisted of twenty-five technical drawings.[6] A set of ten construction drawings admits no ambiguity. The use of accepted signs, symbols and measurements offers a clear understanding of the choice of materials and techniques of construction. To better appreciate the formal, ornamental and technical qualities of these drawings, we translated them into virtual models and inserted them within the current context of the city to comprehend the value concealed in the original two-dimensional representations.

[5]On the 27 October 1932 he wrote: "1° the home must conserve its original appearance (…). 2° the external façades must be consolidated and clad up to the second floor maker, with Travertine stone. This cladding structure will create pilasters projecting from the original wall by 7–11 cm and frames around the doors, the original balconies and windows (…)".

[6]The second project, much smaller, is from 1934 and was developed together with the Pescara Civil Engineering Department.

As for the clarity of communication, there was an attentive relation with the useful data provided by the project material, connected to produce the desired digital output. This latter is in the end a synthetic medium with the ability to communicate multiple and simultaneous information about what is represented. This activates an interconnection between two aspects whose optimal level is achieved through experience, in other words through the exploration of methods of visual representation on the one hand, and through the attentive reading of important examples on the other, seeking all the while not to distort the original, given that—as Italo Calvino affirmed—a translation is always a form of betrayal. We are thus moving across slippery terrain, as any push forward by the translator runs the risk of denaturing the original as it introduces a new visual language. However, it is also true that this historical drawing is given another life, another dimension.

We thus proceeded with the development of a ‘balanced’ translation, in some cases literal in others free, though in all cases optimal and without ever losing sight of the original meaning: the uniqueness of the original subject. During this process we observed that the translation of two-dimensional technical drawings into 3D digital representations also allowed for the verification of the drawings themselves; it reveals the designer’s inattentions toward particular details and exposes choices that may not have been fully analysed. In fact, 3D visualisations expose the incongruencies of iconographic texts, as digital software uncovers geometric errors and the impossibilities of their physical and material realisation.

The use of 3D technologies provides not only a tool for linking diverse representations developed in two dimensions, but also offers the opportunity to demonstrate the hidden aspects of a project. It can thus be stated that this new form of visualisation is more satisfactory to the eye (and the senses), as it permits a more in-depth and more minutely detailed understanding. What is more, it may also allow for the evaluation of formal choices and techniques selected by the designer. This is possible in the presence of a sufficient number of technical drawings and documents, which allow one to enter into the folds of a project and study its references.

Redefined in this way, 3D representation may become more scrupulous and less ostentatious, while remaining aesthetically pleasing, representing an ideal instrument for controlling what is visualised. This technology can be adopted as a tool for exploring what is not represented and what has not been expressed, opening up possible horizons for exploring unrealised projects. It may also offer a surprising model for examining what may have been excluded.

It is evident that these two products, as Nelson Goodman (1968) claims—differ in some distinctive and denotative properties. The analog products of architecture and design are static interfaces. They induce comprehension and stimulate the imagination, unlike digital products, which offer a dynamic process that directly involves the user. The very fact that a paper drawing adopts a scale of reduction and a geometric model—unnecessary in the world of 3D representation—signifies limiting the former to a circumscribed degree of definition, even if notably broad that, in the second case can be diversified and expanded without prejudicing the impossibility of reciprocal substitution.

The alternative lexicon of the latter, with its immediate and exhaustive communicative abilities, not to mention its accessibility to the vast majority of the general public, becomes ineffective when it is projected toward the realm of construction.

The advantages offered by rendered 3D models, including the possibility to be inspected and 'flown through' as in those we developed, certainly include a heightened introspection and transmission of data with respect to traditional forms of drawing, and to an even greater degree those conserved in an archive. There is a more effective reconstruction of the sense intended by the author of the drawing, resolved in a new figuration that brings something into existence, moving beyond the latent sense of the original image of a hypothetical subject or one that is no longer present.

It is precisely this aspect of communication, the primary necessity of disseminating the results of research, which pushed us to consider the actual forms and tools of communication typical of digital technologies, a field in which we have made various experiments, many of which are on-going. Virtual models are entrusted with communicating an architectural message, in order that it not remain

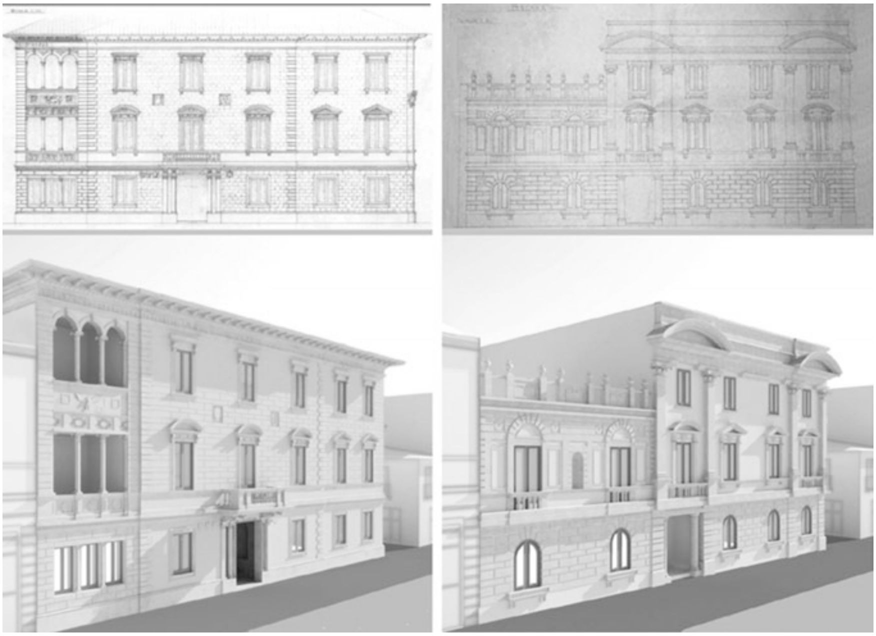

Fig. 1 Ing. Antonino Liberi, first project for the d'Annunzio home, 1926; below 3D digital drawing; to the side, Antonino Liberi, second project for the d'Annunzio home, 1929; below 3D digital drawing

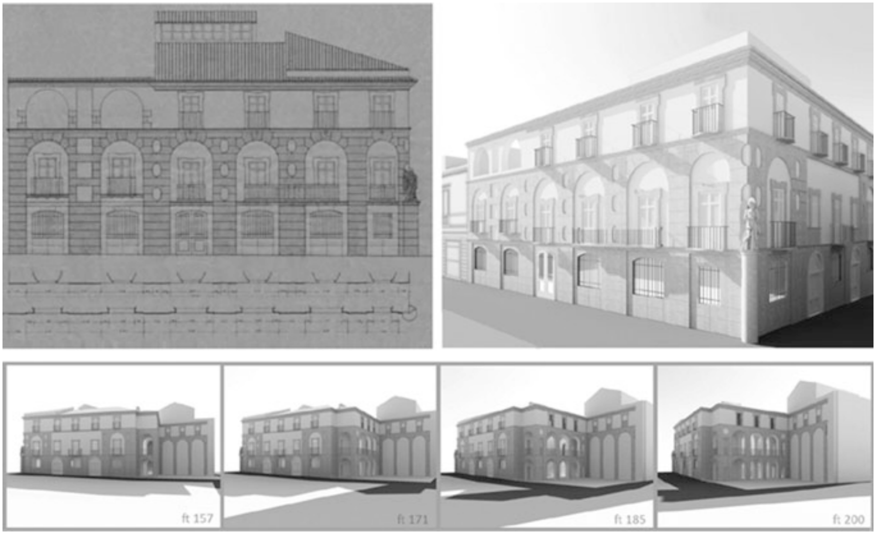

Fig. 2 Arch. Gian Carlo Maroni, project for the d'Annunzio home, 1933; to the side 3D digital drawing; below, extract from photograms of the digital film based on the same project (C. Casulli)

closed up in our laboratories, as the original drawings remained closed in an archive (Figs. 1 and 2).

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“Virtual Recreations of the Vanished Granada” Researching, Representing and Disseminating the Architecture of the Past with 21st Century Tools

Concepción Rodríguez-Moreno

Abstract The history of Granada has been plagued by aggressive urban reforms which changed the image of the city and that significantly decreased its Architectural Heritage. Today we have graphic tools that allow us to *invoke* those architectonic *spirits*, making them visible again: virtual recreations. However, virtual products developed without a firm scientific support can lead to inadequate results, source of historical falsehoods that could distort the memory of the vanished architecture. It is necessary to train professionals fully aware of the importance of intellectual integrity, reliability, transparency, sustainability and access relating to the virtual recreations applied to the research, representation and dissemination of the architecture of the past.

Keywords Architectural heritage · Virtual archaeology · Final degree projects

1 The Vanished Granada

Part of the memory and identity of a city and the people who populated it is lost when a building is demolished. The tragedy of it is that these demolitions were too often justified as the inevitable price that must be paid for progress.

The history of Granada has been plagued by aggressive urban reforms which changed the image of the city and that significantly decreased its Architectural Heritage (Barrios 2002, 2006): the urban grid and the Muslim houses destroyed by the Christian society since the 16th century, the confiscation and destruction of convents, monasteries and churches during the 18th century, the “widening”

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internal reforms that involved the opening of new streets in the historic center of the city between the late 19th and the early 20th centuries, the 50s *Plan de Alineaciones* that allowed the edificatory anarchy with its lax ordinances, 60s and 70s brutal policy of urban development when Granada suffered the greatest destruction of its architectonical heritage and landscape in its history, etc.

Despite the architectural atrocities committed in our city over the years, no effective legislative framework to prevent the deterioration of its urban identity exists today. In a town like Granada, where tourism is perhaps the most important economic resource, many Grenadians do not believe that heritage is a priority, a common good to be protected and preserved. Probably most of them are not aware of the historical significance, architectural quality or uniqueness of the demolished buildings, nor the value of an urban image which is irretrievably altered. It is extremely important to discover and appreciate what is missing in order to understand how important it is to preserve what still remains. The more we know our Heritage, the more we regret to lose it.[1]

We think that researches ourselves are partly guilty of this social misinformation. The studies that we have traditionally done are exclusively directed to the scientific community and the fact is that literary descriptions and survey plans will hardly captivate receivers who are not knowledgeable or not interested about these issues. In the so-called information society era, where technologies facilitate the creation and distribution of knowledge and citizens are fully embedded in digital cultures and increasingly demand audiovisual content, researchers should be able to overcome our own "digital divide"[2] and renew the systems we use to disseminate the results of our investigations.

Fortunately, some researchers are already aware of this and they think, as the architect Antonio Almagro Gorbea (2011, 105) does: "*La informática ha puesto a nuestra disposición unos poderosos instrumentos de visualización y representación que constituyen una revolución en el campo de la investigación del Patrimonio*".

[1]In recent years, global society has been able to know firsthand the brutal destruction that the Middle East Heritage is suffering. As a result, we have become aware of the incalculable value of the disappeared art and international institutions have begun to demand measures to protect it, considering intentional attacks on monuments, artwork and other heritage representation as "war crimes". Although the history of war has always been marked by the annihilation of the other's culture as a form of systematic destruction, images broadcasted by the mass media have emotionally impact the world, making us understand how necessary is to protect our global cultural Heritage at all costs.

[2]Although the "digital divide" is related to access and application of information technology limitations, we believe it goes beyond the purely technological in developed countries. Some researchers are voluntary maintaining themselves apart from the benefits of ICT or the use of the recently introduced digital tools and many of them question the real utility or the scientific rigor of the products obtained and disseminated through these new technologies.

2 Virtual Recreations of Architectural Heritage

As advanced in the previous paragraph, one of the great profits of the virtual recreations of Architectural Heritage is the knowledge dissemination (Torres and Rodríguez-Moreno 2007). Traditional methods of representation have low intelligibility to people not used to them—most of the population—so the results of many investigations do not reach the mainstream society.

Audiovisual products that can be generated from virtual recreations of missing architectures—such as renders, programmed animations, real-time animations, etc. —have the ability to convey information in a clear and suggestive way so they impress the viewer more than any other publication.

On the other hand, reconstructing transformed or even ruined buildings digitally is one of the most interesting applications of these recreations. It enables researchers to develop different variants of the same hypotheses and then to compare and verify their potential and probability. In addition, it has an added value for the architects who study the Architectonical Heritage. Virtual reconstructions make possible the visual immersion into architectonical spaces that sometimes are very difficult to imagine and observe from specific positions, so the tour through the missing architecture and the personal experience of the visit are virtually simulated. That way, basic aspects as color, textures, light effects, spatial sequences and scale can also be analyzed (Rodríguez-Moreno 2014).

We are fully conscious that making these virtual products without a firm scientific support could lead to inadequate results, source of historical falsehoods that could potentially distort or replace the authentic memory of the architecture which we intend to recover.

The use of computer applications in virtual recreations has broadly spread between technicians and professionals who are unrelated to Architectural Heritage. In response to social demand for this type of representations they have recreated historic-architectonical scenarios which are technically spectacular but too often no scientifically rigorous (Fig. 1).

Unfortunately, there is no regulatory framework to provide clear and accepted criteria on permissible ranges of the Heritage “virtual intervention” but there has been some progress recently.[3] Obviously these criteria would not have to be as strict as those applied in the restoration of buildings. Virtual recreations do not directly affect the represented architecture but they should implement some ethical principles, similar to those of any scientific work. Researchers must ensure the rigor of their proposals, assess the quantity and quality of information that is available, propose different levels of uncertainty in their recreations and explain the method used in the process that generates the virtual product.

[3]The London Charter (2009) is the most important document adopted by the international scientific community in the field of new technologies applied to Cultural Heritage for the moment. It establishes the basic requirements to get 3D visualizations of the Heritage acquire the same robustness and rigor that other methods of scientific research already possess.

Fig. 1 *The patio de Comares* of the Alhambra in the 15th century according to the videogame Assassins Creed: Brotherhood, produced by the company Ubisoft Montreal. In our opinion, the virtual recreation of such a magnificent architectural space deserves many adjectives, most of them inappropriate to be reproduced on this communication

In Fig. 2 we present our own method to generate a virtual model of the Architectural Heritage. It all started, when possible, with detailed planimetric survey of archaeological remains. Broad historical, graphical and documentary research of available primary and secondary sources is carried out simultaneously. This research is focused not only on the building that is being recreated but also on other similar buildings, contemporary or not. Once collecting and analyzing all this basic information first reconstructive hypotheses of disappeared architectonical spaces are made.

This is a really interesting work which requires the researcher to imagine the architecture in all its spatial and temporal extent and to put himself in the shoes of the one who originally conceived it. In our opinion, the creative process of any architectural project, in its essence, has not changed too much to one to other time in history. Only the conditions, the techniques, the materials, the standards, etc. have multiplied and diversified. Certainly this methodological stage is the closest to our profession of architect.[4]

Once reconstructive hypotheses are defined, early 3D models are generated. They provide materials with textures, colors and light effects and also support

[4]This premise is precisely what led us in writing of the book *El palacio de Pedro I en los Reales Alcázares de Sevilla: estudio y análisis* (Rodríguez-Moreno 2015). We boarded a thorough architectural analysis of the Alcazar de Seville in the 14th century from the perspective and tools used by an architect, assessing the factors that differentiate Architecture of the rest of artistic productions: the relationship with the urban environment; functionality; logical composition and metrics of architectural spaces; the importance of light, color and beauty; the meanings and emotions that this architecture should have transmitted in the past, etc.

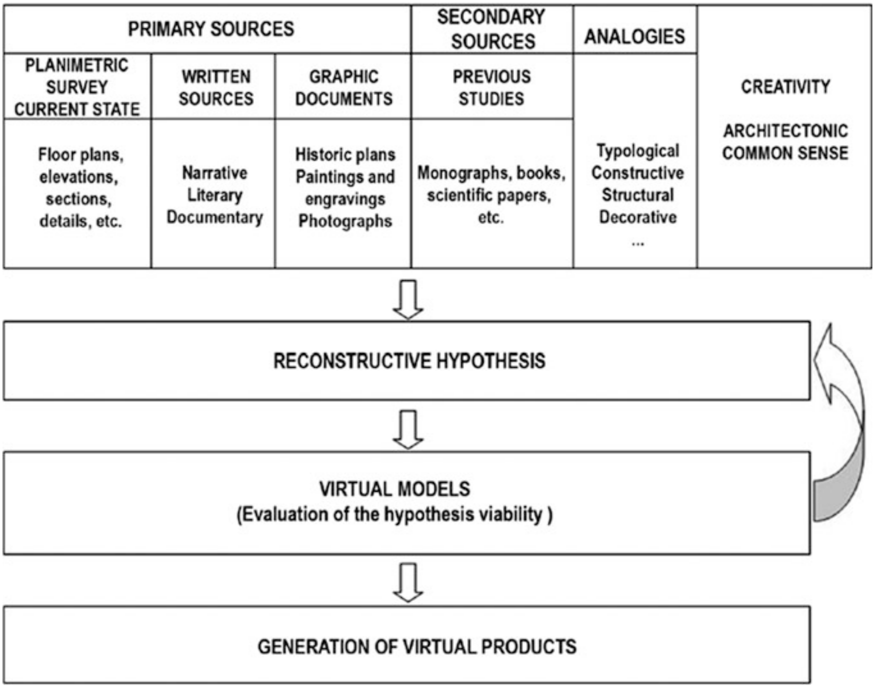

Fig. 2 Proposed methodology to generate a virtual recreation of the Architectural Heritage

metric and sensitive information which are exceptionally helpful to the researcher/architect. Images generated from these 3D models are used to check the viability of the initial hypotheses and to introduce improvements if deemed necessary. An iterative phase is initiated. It ends when the researcher believes the virtual model achieves the objectives that he had previously established for his research (Fernández 2002; Bentkowska-Kafel and Denard 2012).

3 Teaching and Final Degree Projects

As university teachers we think it is also our duty to instruct professionals aware of the importance of applying some basic principles regarding intellectual integrity, reliability, transparency, sustainability and accessibility of virtual recreation generated for research, representation and dissemination of historic architecture. This conviction led us to raise the Final Degree Project line called *Recreaciones virtuales de la Granada desaparecida*, under the support of the Department of Architectural Graphic Expression at the School of Architecture of Granada. We wanted to introduce final-year-degree students to Architectural Heritage research, training them in the emerging discipline of Virtual Archaeology and making them understand that not everything is permitted in a “scientific” virtual recreation.

Final Degree Projects proposed for the 2014–2015 academic-year pursued three objectives clearly related to the methodology expressed in the preceding section of this communication. They intended to guide students to acquire some specific skills:

– Research of the historical, textual and graphic documentation of the disappeared Architectural Heritage.
– Performing reconstructive hypothesis (planimetric and volumetric).
– Developing of new material, graphical and/or multimedia, to spread the investigated Architectural Heritage.

The students Agata Michot Roberto and Rocio Salazar Ortiz decided to work on two disappeared Grenadians buildings: the *Cetti Meriem* Palace and the *Casa de la Lona*. After six months of investigation, the results obtained by both students have received very high marks. Perhaps these works are the beginning of two upcoming —and promising—professional careers oriented to the research of our rich Architectural Heritage.

4 Results: The Cetti Meriem Palace (Michot 2015)

In 1901, the “widening” internal reforms and the construction of the street called *Gran Vía de Colón* ended up destroying the last vestiges of what was once the palace of *Cetti Meriem*. Its history dates back to the second third of the 15th century when it was built in the purest *Andalusí* style (Fig. 3).

After the *Reconquista*, the illustrious *Granada-Venegas* family, owner of the palace and relatives of the Nasrid royalty, decided to transform the original building to adapt it to the likes of the Christian elites. This implied significant changes in the building organization. Among other reforms, the palace must be extended with a second plant (Fig. 4) and moved the location of its original entrance, perhaps located in the disappeared *Del Rosario* Street,[5] to the widest *Carcel Baja* Street, taking the form of a typical Renaissance façade (Fig. 5).

Between 1530 and 1540 the *Granada-Venegas* family moved his primary residence to the *Casa de los Tiros*, located outside the ancient *medina* of Granada. The *Cetti Meriem* Palace would begin a long period of decadence that would culminate in its total destruction in the early 20th century.

[5]The investigation conducted by the student includes an interesting chapter on the evolution of the parcel of the palace between the 15th and 20th centuries. Historical maps and a curious sketch of the 19th century describing the archaeological discoveries made nearby the palace allow her to perform an interesting hypothesis about the location of the Moorish entrance of the palace, not raised by any other researcher until now.

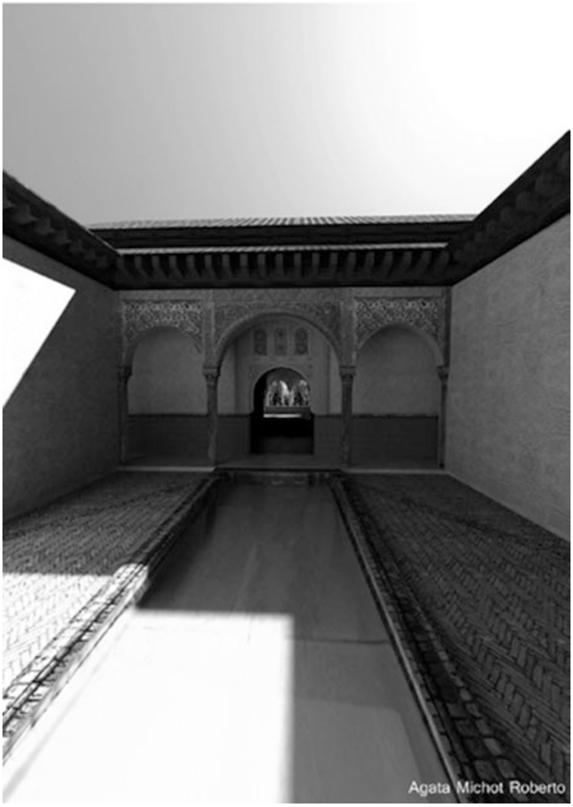

Fig. 3 Virtual recreation of the courtyard of the Cetti Meriem Palace in the 15th century

Over more than three centuries, the palace suffered re-parceling and several extensions and additions that were not registered. Only in the late 19th century, when the demolition of the building was announced, the organization called *Comisión de Monumentos* decided to study it in detail, producing numerous sketches and photographs that were used to document its condition (Fig. 6).

Some archaeological excavations were also carried out and certain decorative elements were transferred to various city museums. Casts of the impressive Moorish plasterworks were extracted too. The aim of the *Comisión de Monumentos* was rebuilding the palace elsewhere, but the project was finally abandoned due to the limited budget.

In her Final Degree Project focused on the virtual recreation of the palace of Cetti Meriem, our student provides an important document that not only collects unpublished historical data and previous research (Valladar 1899, 1901; Torres Balbás 1923; Orihuela 1996) but also advances in the knowledge of a disappeared —and almost forgotten—architecture, giving interesting proposals that could be subject of future studies.

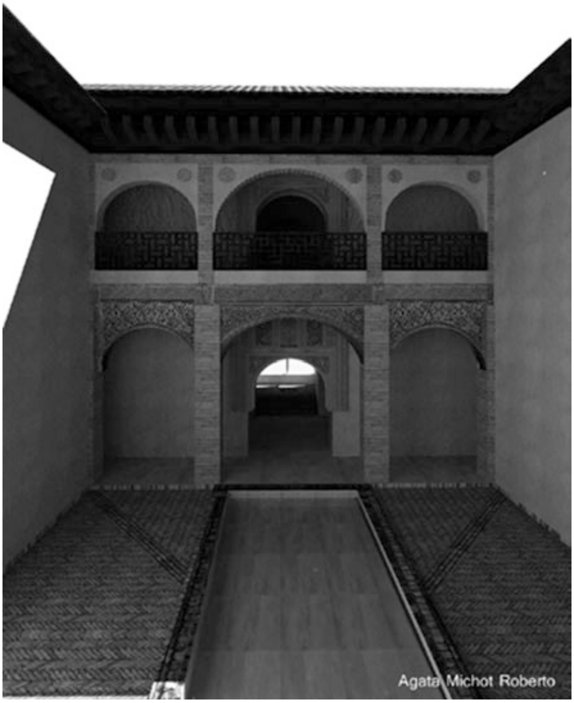

Fig. 4 Virtual recreation of the courtyard of the Cetti Meriem Palace after its 16th century transformations

Fig. 5 Virtual recreation of the Renaissance façade of the Cetti Meriem Palace which was opened to *Carcel Baja* Street

Fig. 6 Some photographs of the Cetti Meriem Palace taken by the *Comisión de Monumentos* before the demolition of the building. Provincial Historical Archive of Granada

5 Results: The Casa de La Lona (Salazar 2015)

Until its demolition in the early years of the 70s the *Casa de la Lona* was one of the most famous and characteristic buildings of Granada. It was located in the popular neighborhood of Albaicin and hosted a lively *corrala* where more than two hundred families came to live together (Fig. 7). However, few of them knew that their houses had been erected over the first *Alcazar* of Granada, built in the 11th century by the *Ziri* dynasty.

There is only a monographic publication on this building. It is primarily focused on the interpretation of a few archaeological remains that were documented before the demolition of the edifice (García and Martín 1975). The Final Degree Project centered on this disappeared architecture analyzes its different historical phases over a period of almost ten centuries. It also proposes suggestive reconstructive hypotheses of these phases: the 11th century Ziri palace that was later transformed into a Moorish house (Fig. 8); the Renaissance palace overlooking the valley built by the Genovese merchant called Rolando Levanto which possibly involved the construction of new buildings and the extension of previous structures; the building in the late 17th century, when it was donated to the Catholic Church and probably

Fig. 7 The *Casa de la Lona* before and after its demolition.Photographs by Juan Antonio García Granados

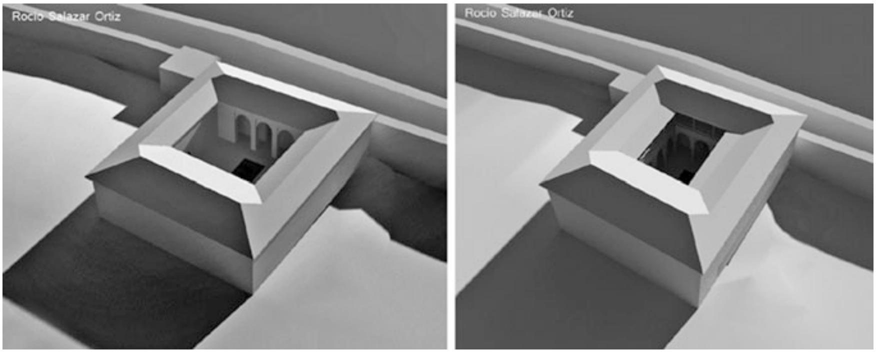

Fig. 8 Virtual recreation of the first Ziri palace (*left*) and its subsequent Moorish transformation (*right*)

used as a haven for beggars; its transformation into a canvas factory in the late 18th century, involving the addition of several parcels, the construction of two new buildings for the looms and the opening of new streets which facilitated transporting commodities and products (Fig. 9); the building in 1902 when it was reformed and expanded to become the famous *corrala* that lasted until 1975, when its deplorable conditions advised demolition (Fig. 10). In the place once occupied by this historic building there is now only a parcel full of debris and trash.

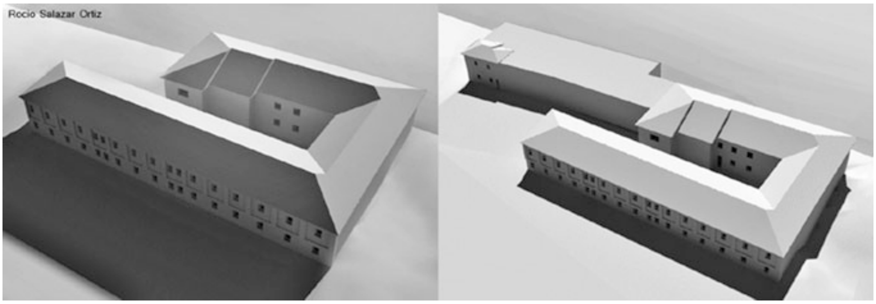

Fig. 9 (*Left*) Virtual recreation of the building in the late 17th century, when it was donated by the Levanto’s family to the Catholic Church and transformed into a haven form beggars. (*Right*) Virtual recreation of the canvas factory in the 18th century

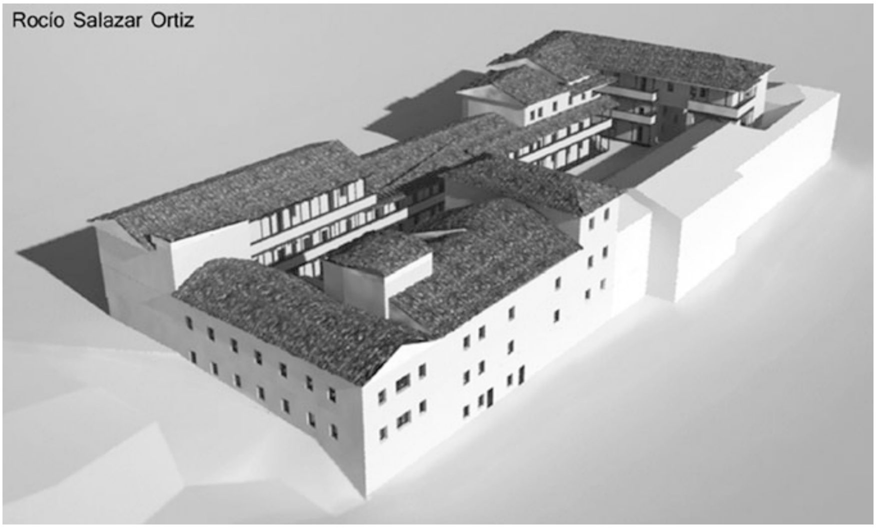

Fig. 10 Virtual recreation of the Casa de la Lona in the 20th century, when it hosts the popular *corrala*

6 Conclusions

Although it is obviously necessary to apply a multidisciplinary approach when we face up to the knowledge, conservation, consolidation and restoration of the Architectural Heritage, we think that the analysis of the historical architecture that has been done, and partly continues being done, does not completely satisfy the requirements in order to understand the architectonical phenomena of a certain time. The architectural fact is too often studied as a ceramic fragment. No specifically architectonical arguments, descriptions, tools or techniques are used. The particular vision of the architects is absent: the Architecture is a receptacle where life unfolds, an appropriate response to physical and spiritual needs of man and society, a work of art to be enjoyed with all our senses.

There are still few architects who are dedicated to the study, representation and dissemination of Architectural Heritage from a suitable approach, applying clear ethical standards and integrating the necessary background. We think the Final Degree Project line "Virtual Recreations of the vanished Granada" will serve to guide our students in the right direction.

On the other hand, research on the disappeared Architectural Heritage have been limited to articles where more or less rigorous planimetric surveys of the remains are collected and texts that attempt to describe how these architectonical spaces may have been are included. Sometimes these articles also present hypothetical plans, elevations and sections but very few dare to virtually reconstruct the destroyed architectural spaces.

Virtual recreations of disappeared buildings and urban environments are very powerful graphical tools in this regard. They not only allow us to "invoke" our architectural "spirits" but also get them accessible and attractive to the current society. Researching, representing and disseminating the architecture of the past with 21st century tools is possible today.

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The Development, Recovery and Reuse of the Architectural and Urban Heritage: Former Barracks as University Location

Antonella Salucci

Abstract The contribution proposes an investigation on the Villarey former barracks, an historic building considered part of the architectural heritage of down-town Ancona (Italy), recovered as a university location. The methodology includes two main fields of observation: on the one hand, the analysis of the original design drawings leading to the building of the barracks (1865–1868); on the other, the reading of the restoration project drawings illustrating the design process for the recovery and redevelopment of the Villarey former barracks as the Faculty of Economics of the University of Ancona, Italy (1989–1998). Through typical methodologies of the disciplines of Representation, the events leading to the recovery of an important urban and social down-town area of Ancona (Italy) can be retraced.

Keywords Heritage · Architectural drawings · Barraks

1 Foreword

This text investigates the relationship between Representation and Architectural Design through a reading of events that led to the renovation and reuse of an important example of architectural and urban heritage in the historic centre of Ancona: the Villarey Barracks, constructed in the mid-1800s. Occupied by an infantry regiment until the Second World War, the Barracks were successively utilised in part as shelter for displaced persons, before falling into disrepair in the 1970s. Toward the end of the 1990s the structure became the object of a vast plan for the rehabilitation and recovery of the Cardeto Park to create a new university campus. Today, the former Villarey Barracks are home to the Università degli studi

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di Ancona's Faculty of Economics. The renovation project was designed to respect the historic memory of the city.

In the text we propose three levels of reflection, paralleled by ten images. They allow readers to retrace the events that led to the urban and social recovery of an important part of the historic centre. The first level of analysis deals offers a comparative reading of original design drawings of the New Villarey Barracks, developed by Valeriano Bernardini in 1868, together with documents related to what was in all likelihood his reference: a prototype barracks with similar characteristics published in 1863 by the Military Engineer Giovanni Castellazzi. This phase was supported by the direct examination of archival material, specifically the vast collection of drawings and texts conserved by the ISCAG, the *Istituto di Cultura dell'Arma del Genio di Roma*. The second reflection looks at the renovation project that culminated, at the end of the 1990s, in the and functional adaptation of the former Villarey Barracks as the new home of the Faculty of Economics and Business at the Università degli studi di Ancona (1989–1998). The third level looks at the person behind this important renovation and his ideas: Carlo Mezzetti (Rome 1933–2009), professor, professional, master and "Vitruvian architect", to whom this text pays homage. The first part of the essay geographically and historically positions the construction of the building, summarising key historic in the city, in addition to looking at a number of projects tied to the evolution of the city's defensive structures that played such an important role in defining its layout.

2 The City, the Barracks, the Prototype

Ancona's geo-topographic position and function as a port constitute the two principal invariants that determined the evolution of its urban fabric, situated between two lines defined by the coast. The form of the city resembles a triangle anchored to the south by the limestone mass of the Monte Conero, and to the east by the line of the upper coast, subject to maritime erosion and defined by Monte Guasco, Monte dei Cappuccini and Monte Cardeto (Pavia and Sori 1990).

The courtyard building of the Villarey Barracks—constructed in the mid-1800s according to the project by the Military Engineering Corps as part of the post-Unification projects to modernise the city's articulated and complex defences—is situated to the east of the port, tangential to the compact fabric of the city and the natural area of the future Cappuccini-Cardeto Park.

One of the primary architectural elements in the urban landscape, the complex occupies almost 1 ha. A true landmark, situated in a luxuriant area near the northern coast, its main elevation represents the backdrop to the axis of Via Indipendenza, which runs north-east from Piazza Cavour (Figs 1 and 2).

The area near the site of the future barracks was originally settled by the Piceni, followed in the 4th century BC by the Dori, the founders of Ancon, a natural port and important reference to the defence of the Adriatic. Ancona became a Roman colony during the Republican Era. As it developed it conserved the original plan of

Fig. 1 Ancona. Satellite view of the area adjacent to the former Villarey Barracks. Google 2015

the *polis*. During this period the defensive system in Ancona consisted of a 2300-m long wall, and a total area of 25 ha. After the year 1000, flourishing mercantile activities brought a notable impulse to urban development and the walls grew to 4200 m in length. The transformation of the city's defensive structures by important military architects made Ancona the most important military outpost of the Papal State east of Rome. Beginning in 1532, to protect against the threat posed by the Turks, Pope Clement VII commissioned Antonio da Sangallo with the construction of a fortress atop the Astagno Hill: the building was characterised by a star-shaped plan with five bastions. Two centuries later, in 1732, as part of plan to re-launch commerce and the functions of the port, Pope Clement XII proclaimed the city of Ancona a "*porto franco*" (free zone) and entrusted Navelli with the project for the requalification and expansion of the port and the construction of the *Lazzaretto*. In 1797, the French and Napoleon occupied the city. The occupation favoured improvements to military structures protecting the city and the port, from land and sea (Pavia and Sori 1990, 48).

The Unification of Italy had a strong impact on the evolution of the city of Ancona, which immediately became of strategic national importance due to the presence of the port. Prior to Venice's becoming a part of Italy, Ancona was the most important naval outpost in the Adriatic, representing a true bulwark against the Austrian fleet. The 1861 Master Plan united the civil needs of the nascent middle class with the requirements of the military, attributing a great deal of importance to the system of defensive works. A consistent military presence during this period is documented in the census taken the same year, which details the presence of 5000 soldiers and a total population of 46,090 inhabitants (Mariano 1987, 176).

Manuals on military architecture are traditionally subdivided into 'fortifications' and 'buildings'. The first were based on theories expounded in treatises from the fifteenth and sixteenth centuries; the second dealt with the realisation of military works—barracks, hospitals, armouries, stables, warehouses—that, following the creation of the *Corpi del Genio* (Military Engineering Corps) as part of modern European armies, were designed and built almost exclusively by engineers and architects who were soldiers by profession (Fara 1985, 9).

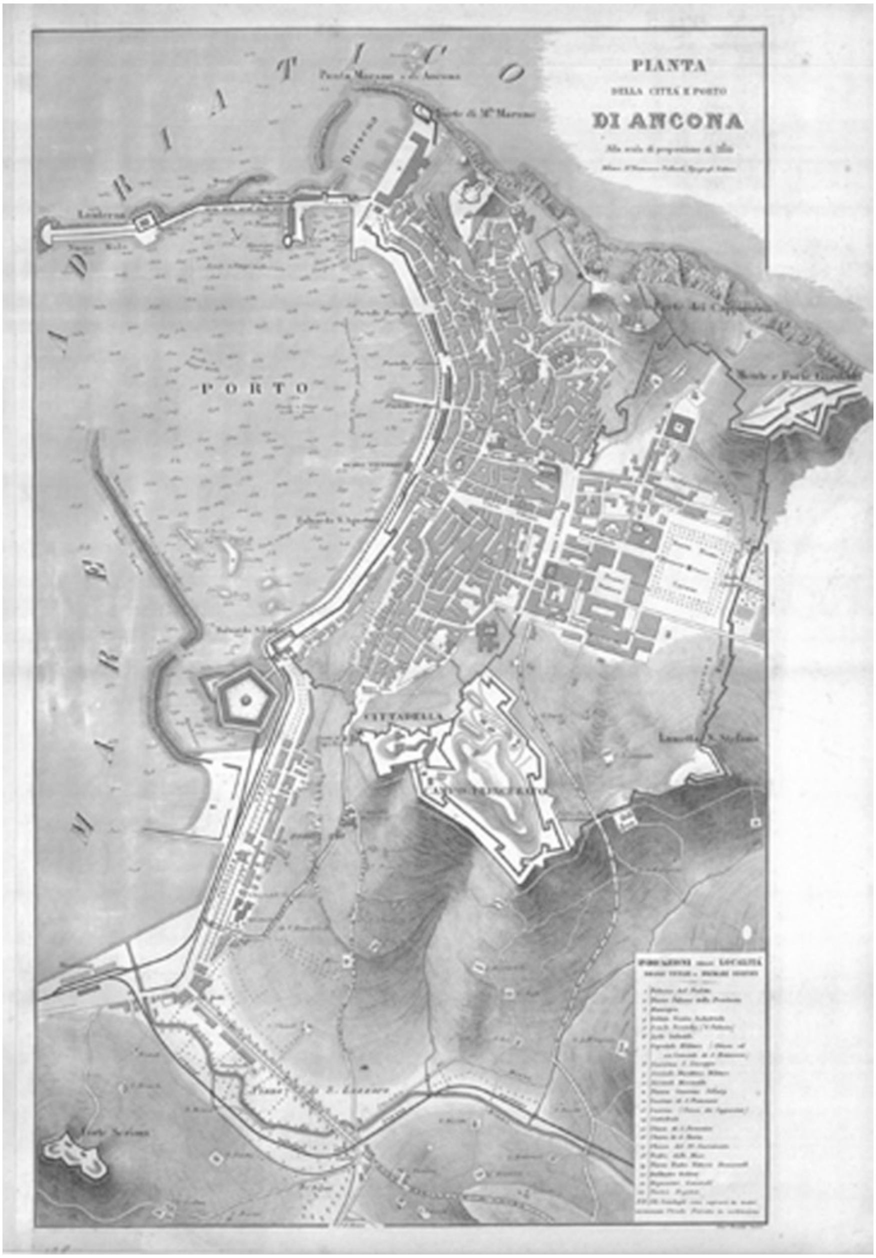

Fig. 2 Plan of the city and port of Ancona. 1868. Engraving 41 × 58.5 cm. *Atlante Geografico dell'Italia.* Francesco Vallardi Editore, Milan

The new Villarey Barracks for the military contingent stationed in Ancona, dedicated to General Maurizio Rey di Villarey, who fell at Custozza in 1866, was constructed between 1865 and 1868, under the direction of Lieutenant Colonel Giuseppe Morando of the Military Engineering Corps (Salucci 2001).

One of the central figures in military architecture from this period was Giovanni Castellazzi, a graduate of the Politecnico di Torino, disciple of Carlo Promis and, after 1848, an official with the Corps. He was responsible for the codification of true prototypes—"designed for maximum economy and speed of construction" (Fara 1985, 38)—that for many years constituted the reference for various projects built in Italy. After 1863 Castellazzi was head of the technical office of the Engineering Corps of Turin; he was commissioned with a two month mission to visit military establishments in France, Belgium and Great Britain and "the various provinces of the Kingdom [of Italy—TN]" to acquire competences in methods and techniques of construction. During this campaign—accompanied by Captain Biagio Debenedictis, from the Corps' office in Ancona—he produced a relevant quantity of full size sketches published posthumously (Castellazzi 1864, 1876).

After Giovanni Castellazzi was named director of the *Giornale del Genio Militare*, he proceeded to publish a selection of his projects for barracks designed to house men and horses. This periodical, founded by the Ministry of War on 18 January 1863, consisted of an "official" and an "unofficial" section. All contents of the first section had to be approved by the Ministry; the second—accompanied by drawings gathered together in an Atlas—was dictated by guidelines for the study and design of new constructions entrusted to Army officials. The "unofficial section" of the third issue of the *Giornale del Genio Militare* of 1863 presented a project for a "Two-storey barracks for an Infantry Regiment with storage": a square plan building with a porticoed internal courtyard. The plans and elevations of this structure served as the reference for the design and construction of the new Villarey barracks in Ancona (Castellazzi 1863a, b) (Fig. 3).

The prototype developed by Castellazzi presented three different solutions for the ground floor and the affinities with the appearance and layout of the building in Ancona can be found in plates 19, 20, 21,—plans, elevations, sections and details —from the *Atlas* provided with the *Giornale*. Looking at these drawings, it easy to identify the typological and stylistic similarities with the drawings for the new Villarey Barracks, designed by Valeriano Bernardini a few years later.

Of the numerous documents that must have comprised the dossier "*Progetto per la Nuova Caserma Villarey*" (Project for the New Villarey Barracks), the *Istituto di Cultura dell'Arma del Genio* (ISCAG) conserves six drawings numbered from 32 to 37, showing plans, elevations and sections. Executed in ink and watercolour on thick paper measuring 68 × 46 cm, the drawings feature an italic script describing their content and the author's name and the stamp, date and signature of the presiding official: "*Valeriano Bernardini disegnò. Ancona, Addì 10 agosto 1868. Tenente Colonnello Direttore del Genio Giuseppe Morando*" (Drawn by Valeriano Bernardini. Ancona. 10 August 1868. Lieutenant Colonel Director of the Engineering Corps Giuseppe Morando). The drawing scale is shown on each of the six drawings: four horizontal sections at 1:400; four vertical sections at 1:200.

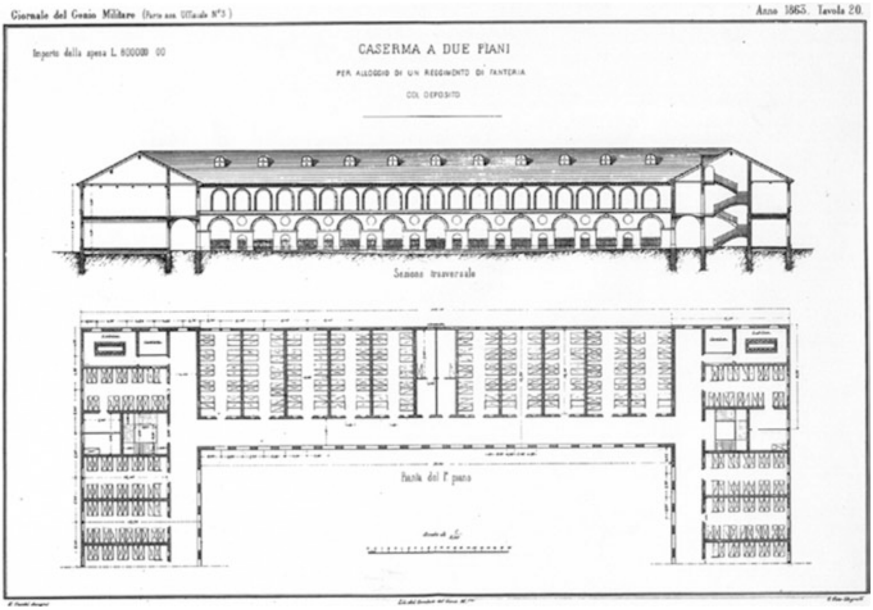

Fig. 3 Castellazzi (1863a). "*Caserma a due piani per alloggio di un Reggimento di fanteria col deposito. Sezione trasversale. Pianta del 1° piano. Scala metrica nel rapporto di 1 a 250*". *GIORNALE DEL GENIO MILITARE*, n. 3, Parte non Ufficiale, Atlante, Tavola 20. ("Two-storey barracks for an Infantry Regiment with storage. Cross section. First floor plan. Scale 1:250", *GIORNALE DEL GENIO MILITARE, n. 3*, *Unofficial Part*, *Atlas*, *Plate 20*)

The page layout includes notes specifying the dimensions—the barracks were designed to host 1280 men on the first and second floors and 14 horses on the ground floor—and the date of construction and costs: "*questa caserma venne costrutta negli anni 1865, 66, 67, 68 mercè la somma di lire 830.000 circa, di cui lire 207.500 per ogni 1st year*" (this barracks was constructed in the years 1865, 66, 67 68 for the sum or approximately 830,000 [Italian] Lira, or 207,500 Lira for each year) (Fig. 4).

The building was designed with an enclosed porticoed courtyard, measuring 62 × 56 m. Its main axis is oriented in the north-west direction. It is comprised of three equal wings forming a 'U', each three storeys in height, connected by a shallower fourth construction that is only two storeys high and situated at the edge of the Cardeto Park.

The ground floor demonstrates a succession of spaces characterised by pier walls, at approximately 6.25 m on centre, set orthogonally to the façade. These in turn support a sequence of polycentric barrel vaults reaching a height of 5.20 m at their centre and 3.60 at their spring point; the bay covering the entry atrium is 5.40 m at its highest point. The "*porta della Caserma*", the entrance atrium, occupies an entire bay and stands at the centre of the main building wing; a second connection with the outside is situated at the left end of the crossing wing.

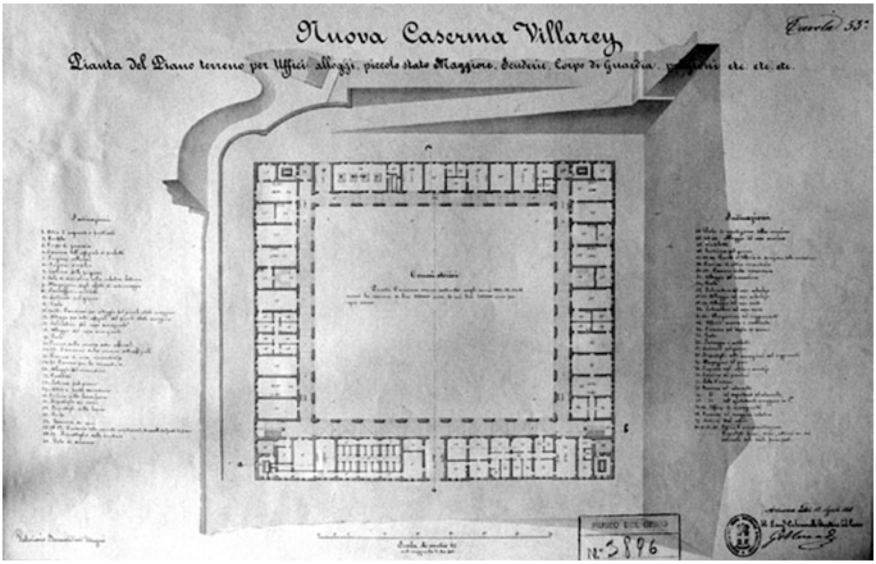

Fig. 4 Bernardini (1868). "*Nuova Caserma Villarey. Tavola 33ª. Pianta del Piano terreno per Uffici, alloggi, piccolo stato Maggiore, Scuderie, Corpo di Guardia, prigioni* etc. etc. etc. *Scala 1:400*". (New Villarey Barracks. Plate 33. Ground Floor Plan with Offices, Lodgings, small General Staff, Stables, Guardhouse, prisons, etc., etc., etc. Scale 1:400). Historic Archives of the *Istituto di Cultura dell'Arma del Genio di Roma* (ISCAG)

There are a total of five stairs, equally distributed along the portico; a service stair serves the smallest wing, while the other four are located in the east and west wings; the main staircase, larger and with three ramps, are positioned at the centre, while the secondary stairs with two ramps are at the south end. There are two vertical sections, shaded and drawn at a scale of 1:200 on plate 37.

The "Section CD" is taken along a vertical plane cutting through the main axis of the building; it looks toward the west wing, offering a view of the internal elevation and cutting through the three-storey south wing, along the entry atrium and through the stables of the two-storey north wing.

The "Section AB", with looks toward the north wing, cuts through the main wing of the building along parallel planes, passing through the corner block of toilets, the corridor of the prisons, the guardhouse, the entry atrium, the offices and the stairwell. This drawing depicts the characteristics of the construction of the foundations, the load bearing structure, the stairs, the barrel vaults covering the ground and first floor rooms and the pitches of the main roof supported by wooden trusses.

The metal balustrades of the stair are represented in blue.

The building was constructed entirely in *a sacco* (rubble) masonry faced in white stone from Monte Conero and pink stone from the Furlo Pass, with intermittent double brick courses (Fig. 5).

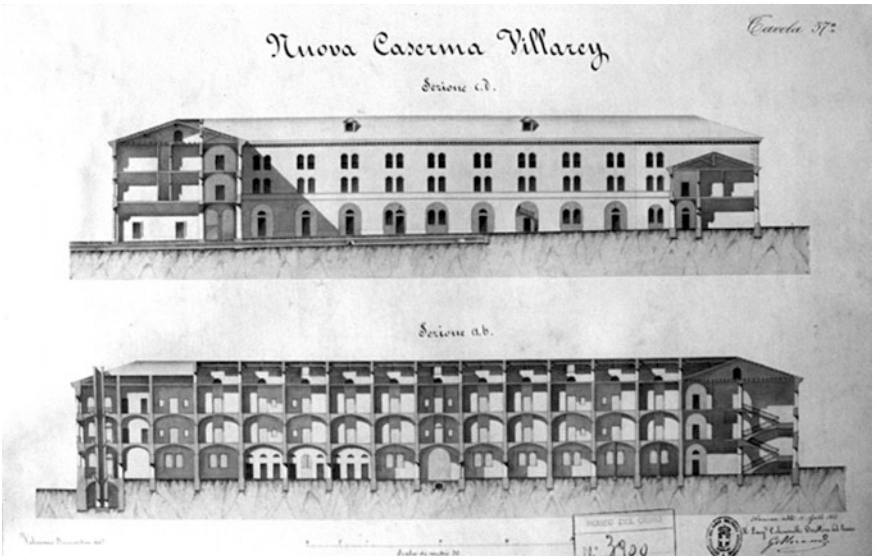

Fig. 5 Bernardini (1868). "Nuova Caserma Villarey. Tavola 37ª. Sezione CD; Sezione AB. Scala 1:200" (New Villarey Barracks. Plate 37. Section CD; Section AB. Scale 1:200)

The external elevations show a stone skirt surmounted by: a flat rusticated base of elements with rounded corners, a tall flat floor marker and two upper levels finished in smooth plaster; rusticated corners mark the edges of projections at the corners and along the axis of the main entrance.

Unlike the external façades, which feature small projections and setbacks that define a progressive play of *chiaroscuro*, the elevations of the internal courtyard are characterised by a decorative approach that plays with surfaces: a homogenous pattern of ochre bricks alternates with courses in red brick used to reinforce the architectural features of the portico and bifora windows on the upper storeys and the floor marker at the first floor.

3 A Barracks for the University

The project to renovate the former Villarey Barracks was commissioned to Carlo Mezzetti, Luigi Ramazzotti and Giuseppe Tardella by the Università degli studi di Ancona; structural engineering was entrusted to Giovanni Menditto; mechanical and electrical engineering to Fulvio Capparelli; work supervision to Carlo Mezzetti and Giovanni Menditto; the contractor was the ATI SOGECA srl of ing. Gerolamo Nardella of Naples. The story of this complicated undertaking, begun in 1989 and concluded in 1999, is summarised in article by Gabriele Milelli, a historian and professor with the Università degli studi di Ancona, published in 2000 in

L'Architettura Cronache e Storia. He notes that, despite the numerous difficulties presented by a very particular urban condition and the complex restrictions imposed on the designers, the need to design a new home for the Faculty of Economics and Business was approached as a challenge and opportunity to create a work of architecture.

Planning regulations required different solutions to diverse orders of problems, and the specific needs of the new Faculty of Economics: transforming and requalifying a portion of the city that included an imposing abandoned military structure; establishing a new presence for the university in an area adjacent to the historic centre, favouring the integration between students and the city; opening up a connection between the city and the view toward its northern coast.

The clarity of the original *parti* constitutes the matrix of the reorganisation of the complex system of classrooms, reading rooms, service blocks, libraries, departments, etc. that make up the new Faculty. The project adapts to the formal characteristics of the original construction, a true "urban document" of pre-Unification Italy.

With respect to the modular rhythm of the original plan, the project exalts the nodes of vertical connection recognisable in the "two double devices of stepping ramps and normal stairs, travelled respectively in the clockwise and counter clockwise directions, whose landings are situated in correspondence with the floor levels and stair landings" (Milelli 2000). An imposing structure in reinforced concrete, with a marked difference in scale with respect to the other parts, overlaps the old structure, substituting the former wing of the stables with a system of large classrooms covered by a roof of different sloping planes.

The new elevation features a two-tone finish of white-grey stone, with different openings bringing light into the complex system of ramps and landings leading to the large classrooms that substitute the former wings of the stables. The summit of the elevation features a tympanum motif that reveals the playful nature of the new laminated wood roof structure.

A raised pedestrian gangway leads directly from the intermediate level of the classrooms to the roof of the parking structure, which also serves as an outdoor the atre. This space creates a connection with the planned Cardeto Park through the landscaping of the internal courtyard and the introduction of a centrally positioned fountain. All of the new functions fully respect the existing structure (Figs. 6, 7 and 8).

4 A Vitruvian Architect

We conclude this text with a look at the creative history of the author of the renovation of the former Barracks—Carlo Mezzetti (Rome 1933—Rome 2009)—based on the structure outlined in Franco Purini's Presentation to the monographic publication *Carlo Mezzetti. Itinerari di architettura*, from October 2007 (Sardo 2007).

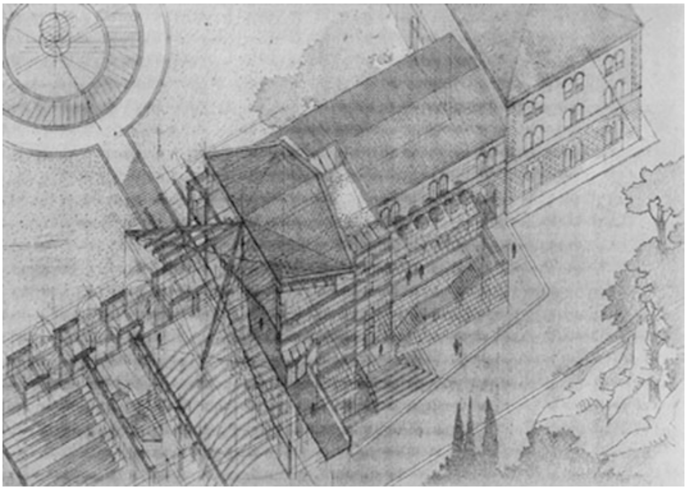

Fig. 6 Mezzetti (1995). New faculty of economics in the former Villarey Barracks, Ancona. "Axonometric view of the wing of large classrooms". Pencil and pastel on paper. (Folder n. 335/500)

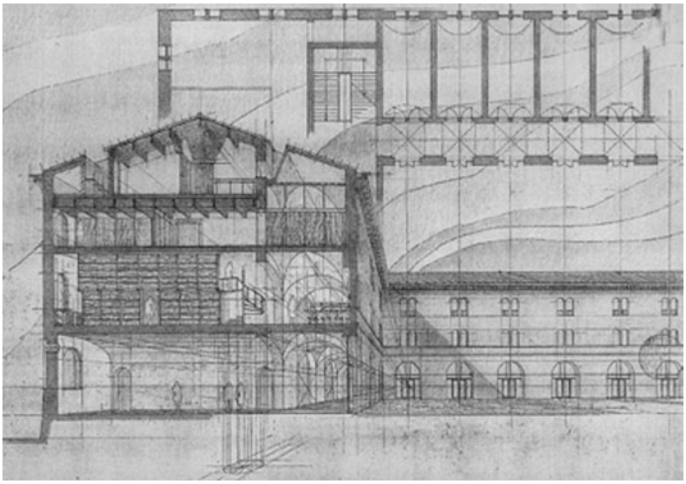

Fig. 7 Mezzetti (1995). New faculty of economics in the former Villarey Barracks, Ancona. "Perspective section of the main 'U'-shaped wing". Pencil and pastel on paper. (Folder n. 335/500)

This large volume, filled with drawings, photographs and critical essays, is a sort of "architectural autobiography (…) a catalogue of drawings to be admired at least as much as they are to be appreciated for the quantity of knowledge contained in each of their lines". Purini refers to Carlo Mezzetti as a "Vitruvian architect able to integrate a rigour of composition and construction and a vocation for the precise

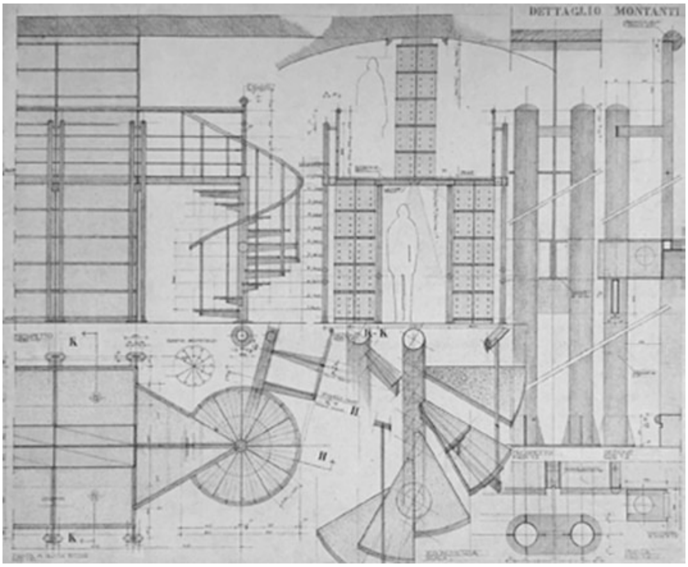

Fig. 8 Mezzetti (1995). New faculty of economics in the former Villarey Barracks, Ancona. "Architectural details of the library shelving module". Lithographic print of a drawing in pencil and pastel on paper; 60 × 50 cm; (Mezzetti 1995). Plate 7 (Folder n. 335/500)

comprehension of place, with everything in architecture that speaks of emotion and mystery" (Purini 2007, 7).

Purini's essay highlights "four guiding lines" of research that connote Mezzetti's talent for composition, recognisable in: the desire to conceive of and construct buildings with an organic quality; the intention to discover relations between the whole and the detail; the attentive transcription of the values of a building's context; the accurate design of interior space. These orientations converge toward a system of ideas typical of those designers and builders—Vitruvian architects—who see form as the objective of building: "The synthesis of these four directions of research is a poetic that unites a solid theoretical base with an innate talent for composition, without ignoring a pronounced propensity toward experimentation that becomes a positive restlessness, an attitude bent on deciphering sites and contexts, on dominating difficulties, and a love for all things new".

Working with the existing, according to this method of design, is the result of a process of investigation that generates new stimuli for design: "managing to intercept the themes that history has selected as it progresses signifies also being able to give one's writing a narrative dimension, something that without a doubt occurs in the work of Carlo Mezzetti".

A final aspect of this condition is specific to the project examined here, where the system of vertical connections plays a fundamental role: "stairs, walkways, opaque or transparent roofs, double heights, the insertion of backdrops screening views, with the effect of a mise-en-scène of subtly scenographic values, inscribe within the building a system of spatial compressions and dilations, the localisation of perspectival vanishing points and shifts in scale that defines a building whose general composition is of notable architectural quality" (Purini 2007, 9). Finally, the relationship with drawing. Carlo Mezzetti is a "an assiduous and intelligent designer; he does not see representation as a simple, even if fundamental instrument of research. For him, as it was and is for other important architects, including Mario Ridolfi, Carlo Scarpa and Carlo Aymonino, the drawing is where the idea of architecture is offered up to the imagination as a vital nucleus, dense with possible evolutions. The crucible into which the various components of architectural form are fused into something perfect and lasting. Drawing as the form of what has yet to take form, but also as the eternal residue of a work of architecture, its simulacrum that escapes the flow of days and years, consigning the work itself to its own immutable perfection".

In short, a "Vitruvian architect" whose works of architecture are marked by a great care for details and the design of interior space, "considered not only as fields of advanced technical and linguistic solutions, but above all as logical-poetic models of the entire building, precious fragments in which a cosmic echo must resound" (Purini 2007, 9) (Figs. 9 and 10).

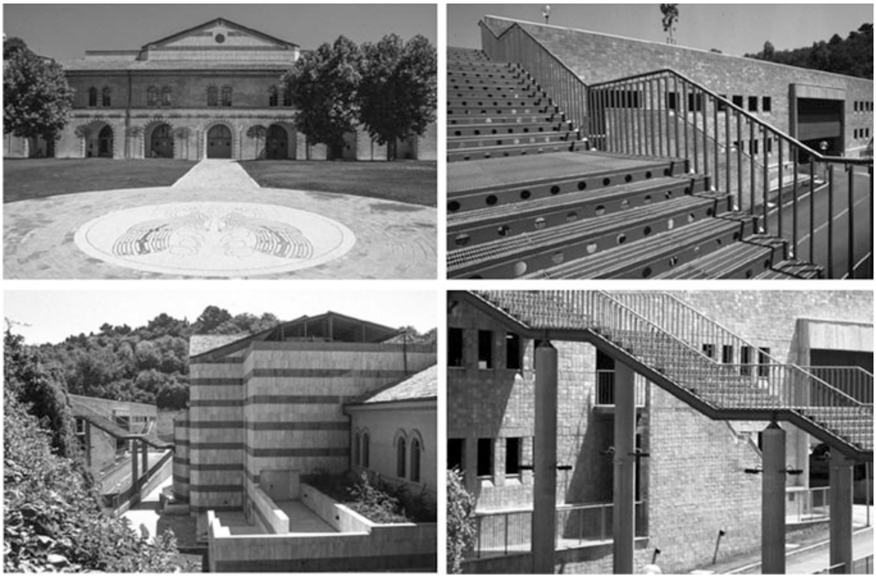

Fig. 9 Carlo Mezzetti. New faculty of economics in the former Villarey Barracks, Ancona. Exterior. Photographs by Antonella Salucci, July 2000

Fig. 10 Carlo Mezzetti. New faculty of economics in the former Villarey Barracks, Ancona. Interiors. Photographs by Antonella Salucci, July 2000

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Aerial Digital Photogrammetry and Terrestrial Laser Scanning for Reconstruction Hypothesis of Monumental Building Lost Façades: The Case of Villa Mondragone

Saverio D'Auria, Giuseppe Sini and Rodolfo Maria Strollo

Abstract The analysis of an historical building requires the fundamental acquisition of metrics data, iconographic and archival documents followed by an accurate interpretation of the collected information. The aim of this methodology is to give a precise critical interpretation of the architecture as close as possible to reality, such as to allow a reconstruction of those characteristic that have been irremediably altered over time. This paper, in particular, explains the philological reconstruction of two facades of Villa Mondragone, lost during some huge functional rehabilitation of the building, obtained with the support of advanced methodology of indirect survey (terrestrial laser scanning and aerial digital photogrammetry).

Keywords Aerial photogrammetry · Terrestrial laser scanning · Digital philological reconstruction

1 The Ville Tuscolane Complex and the Developmental Phases of Villa Mondragone

The complex of Ville Tuscolane includes a main group of twelve monumental factories built around the city of Frascati, towards the middle of the sixteenth century as summer residence of papal court and the families related to it (Strollo 2004). The increase of the Villas building construction was probably due to the

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same oro-geographic and geological causes that led Romans to do the same thing: dry and windy weather on summer and mild on winter, soil fertility, the presence of water, the availability of many high-quality building materials (for example some kind of stones like lapis gabinus of Tuscolo, peperino, basalt, pozzolana) and the strategic location, higher than Rome and its countryside (a suitable aspect both for defense and landscape), made that area the perfect habitat to live in since antiquity.

For the reasons previously mentioned, Roman aristocracy of Renaissance moved to Colli Tuscolani because they wanted a Casino where to live according to the Roman ideal of otium. The plan of this first housing units was initially inspired by the Tuscan tradition of villa-castello whose peculiarities were angular towers and airy loggias.

Later, all the original plans of the Complex were enlarged, adding new wings that followed the strict rules of symmetry volumes and that generally characterize the definition of factories architecture in its current forms.

So, the structure of the north-facing façades (towards the valley) was characterized by austere openings, smaller than the once on the south sides and that, together with the porticos on the ground floor, made the façades more well-structured and brighter. Furthermore, considering orogaphic conditions, they decided to create massive walls of containment both upstream and downstream in order to have level surfaces where they could situate the Villas with their courtyards and parterres.

At a later time, between the end of the sixteenth and the beginning of seventeenth century, the Villas underwent few maintenance works and significant transformations of the external area with the arrangement of gardens and parks. In conjunction with the transfer of papal summer residence to Castel Gandolfo (taken place in 1626 per Urbano eighth's wishes) the interest towards Ville Tuscolane decreased and for many residences started a long process of functional transformation which was the first cause of alteration of their original structures.

Moreover, since the late nineteenth century and for a great part of the last, changes of ownership, the continuous functional recovery interventions that affected most of the factories and the direct or indirect damages due to the Second World War marked, in many cases, irreversible transformations far from the canons of correct intervention on monuments, with the loss of entire *facies*, whose reading and knowledge is not possible today without specific philological investigations.

Villa Mondragone also followed the same evolution both of splendor and decay of the others Ville Tuscolane (Grossi Gondi 1901; Ehrlich 2002). As a result of the transfer of papal summer residence to Castel Gandolfo, the entire complex underwent an increasing state of abandon, culminated in the early decades of nineteenth century when some events (especially an earthquake in 1806 and the quartering in 1821 of thousands of Austrian foot soldiers and riders headed for the Kingdom of two Sicilies) caused such a large numbers of damages that the populations and the administrators of Frascati were pushed to rise up in order to obtain safeguard measures.

This disastrous decline is shown by few iconographic documents and by some description of that period that denounce, for example, lack of roof, walls partially collapsed and windows without frames, especially on the west side of the factory (the so-called Manica Lunga) and also the precarious condition of pavements in the wide Piazzale Maggiore courtyard. This situation was gradually making the artifact almost a ruin.

During the second half of 1800 Prince Borghese's decision, who tried to start a truly remarkable restoration in 1853, lifted the ruinous fate of Villa Mondragone: in fact, he made a deal with Jesuits by which the noble family allowed the settlement of a Jesuit college in its real estate dispensing with the rent but asking the religious to take charge of the restoration of Villa. So, since 1865 the Jesuits realized many maintenance works in Mondragone: one of the most relevant was the closing of tubes of Piazzale Maggiore porticos using glass walls. Others interventions concerned: plans adjustments, creation of toilettes, re-paving, restoration of main stairway marble cladding and closure of hundreds of scaffolding holes.

Since the start of Noble College training program the factory underwent continuous modifications to meet the growing demand for enrollments and the consequent need for optimization of spaces and functions. By the end of the nineteenth century the success of the Collegium Tusculanum significantly increased and its doors were opened not only to the noble part but also to the richer middle class and the others affluent members of society. In 1895 since the Borghese's finances were running out, the College was saved by Jesuits who acquired the property, changing their attitude to the real estate. In order to face up to all these enrollments, mainly grown after the official recognition of Noble Mondragone College to Royal Institutes, in 1926 the roof of three-sides porticoed cloister situated in the western bastion was made; this new environment was intended to be a refectory.

As you had to go from room to room as in the noble apartments. Therefore when the building became a College, students had to go out in the court to reach the different classrooms" (Bondani 1996), starting from 1929, the Rector of the College, Father Aristide Delmirani, entrusted the planning of transformation of Villa to the engineer and architect Clemente Busiri Vici. In less than four years new volumes were created, for example large connecting corridors on the various floors of the western and southern arms facing Piazzale Maggiore, a gym-corridor in the east and few rooms for religious in the turret, upsetting the original prospects plan on this internal court of the factory (Fig. 1).

To soften the invasiveness of these new buildings, Busiri Vici decided to dismantle and re-situate the lapis gabinus of Tuscolo on the newest and most advanced façades. The operation, only partially possible if some obvious geometric considerations are made (the advancement of perpendicular fronts within a concave angle leads to their superimposition) and, therefore, inevitably destined to distort the peculiarities of the angles themselves and the original plans of Manica Lunga, was generally accomplished in a rather rough way (Strollo 2006).

A new period of decline started for the building when the College closed in 1953 (Maestri and Strollo 2002), partially held back by some restoration interventions promoted by University of Rome Tor Vergata that acquired the property in the 80s.

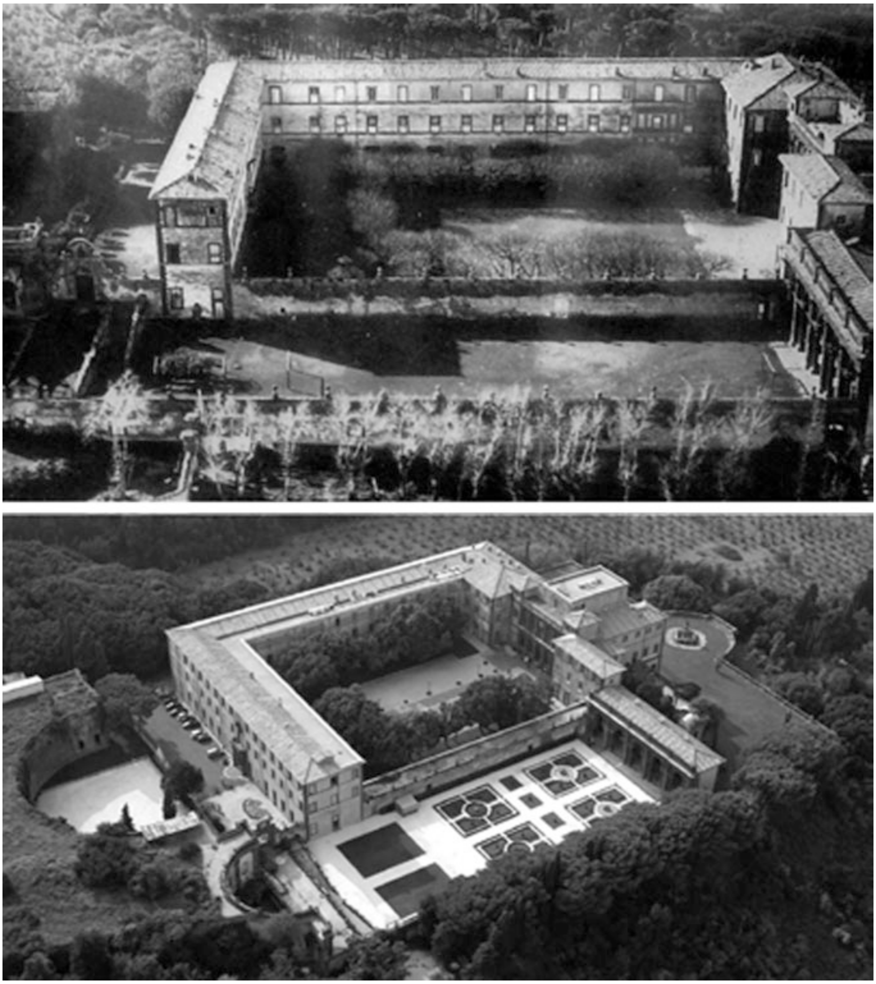

Fig. 1 Two aerial photographs of Villa Mondragone complex related to the period before 1929 (*top*) and 2004 (*bottom*)

The analysis of the interventions described clearly shows how the process of knowledge of the factory can't be based only on a historic study of sources but must necessarily be supported by scrupulous surveys, interpreted and red by a technique. This essay aims to deal with a critical reading about some specific fields of Villa Mondragone completing the archive-historic information with laser scanning and photogrammetric surveys in order to enable a reliable philological reconstruction of those *facies* lost through the time and, in particular, the fronts of Manica Lunga facing Piazzale Maggiore.

2 Laser Scanning and Photogrammetric Survey of Manica Lunga and Southern Arm. Methodological, Operational and Technological Aspects

Having the building a wide and articulated morphology, it was necessary to prepare a preliminary and careful project of survey. We chose to employ a phase-based laser scanner to reveal the internal area of Manica Lunga enlargements and the one of southern arm and the corresponding fronts facing Piazzale Maggiore, and a digital videocamera placed on a UAV to survey the western external façade of Manica Lunga which didn't undergo any kind of restorations, essential to obtain data and geometric-compositional proportions of the symmetric internal façade lost in 1929. For this front, the aerial digital photogrammetry enabled to overtake some obstacles related to terrestrial laser scanning, especially due to orographic and natural conditions of surrounding areas (rough and leaning ground and high-growing trees, too close to the façade) and the considerable height of the factory.

Finally, in order to define the planimetry of the volumes added at the beginning of last century and to complete with roofing the digital model of Villa, a digital camera and a drone were employed, different from the previous ones for technology and performance (Fig. 2).

The laser scanner model employed for this case study is Faro Focus 3D X 130 that guarantees, in optimal environmental conditions, a scanning range between 60 cm and 130 m, a speed measuring of 976,000 points per second, a linearity error between −2 and +2 mm. The settings employed for the 75 scanning produced were two: one for the external surfaces (resolution 1/2: one point acquired each 3 mm at 10 m distance; 3× quality; speed scanning 244,000 points per second;

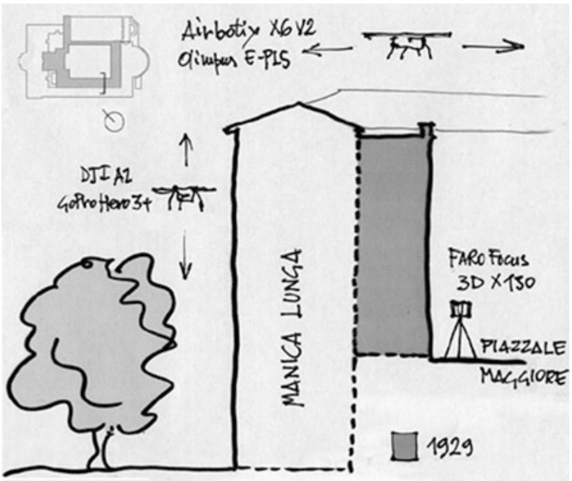

Fig. 2 Schematic drawing of tools used for the survey of Manica Lunga

84 photographs per scanning; duration of each scanning: 10 min and 31 s), the other for the external areas (resolution 1/5: one point acquired each 7 mm at 10 m distance; 4× quality; speed scanning 122,000 points per second; 84 photographs per scanning; duration of each scanning: 3 min and 42 s). The choice of instrument settings was induced by the degree of resolution expected in the final graphics (Table 1).

The first operation was to create a new project: the software automatically organized a hierarchical structure of folders and subfolders where rough scans and the chronology of operations made on them were archived. Once the scans were imported within the project, it was necessary to align them, that is to position them correctly according to a single reference system. This operation was made in a semi-automatic way because during the phase of survey we use spherical targets on horizontal surfaces and checkerboard targets applied on the vertical ones. The non-perfectly aligned scans underwent a manual processing of spatial arrangement through the identification of analogous points on consecutive point clouds. 3D model obtained has more than 400 millions points and represents a very large section of Villa Mondragone, i.e. the first two floors of the enlargement designed by Busiri Vici in 1929 with the façades internal to Piazzale Maggiore (Fig. 3).

As stated above, aerial photogrammetry was employed to reveal the external façade of Manica Lunga and the roofing of the entire Villa Mondragone. The technique of photogrammetry has been using at least for a century in cartographic field and it represents one of the most reliable method for the acquisition of metric and thematic data, successfully employed in architecture too. Taking advance of stereoscopic principle, it allows to obtain position, form and dimensions of the objects using information (analogous points) contained within photographs of the same objects shot by different stations (Angelini and Gabrielli 2013). In general, a photogrammetric survey is divided in three phases: acquisition that defines the modalities of photo shoot; orientation that concerns the registration of the shoots and the consequent creation of 3D model; restitution, i.e. all the output and measuring operations. For the case study described in this essay two different kind of drones were employed. For the survey of Manica Lunga external façade we tested an handmade prototype of UAV weighing 2.4 kg, provided with DJI A2 and GoPro Hero 3+, a very light digital camera (80 g) used for sporting; from its full HD videos about 22,000 frames in a resolution of 2 Megapixel were extracted.

Table 1 Laser-scanner Faro Focus 3D X 130 settings

	Spaces	
	External	Indoor
Resolution	1/2	1/5
	1 pt. each 3.1 mm at 10 m	1 pt. each 7.6 mm at 10 m
Resolution	3×	4×
Speed (pt./s)	244,000	122,000
Duration single scan (s)	631	222
Number of scans	29	46

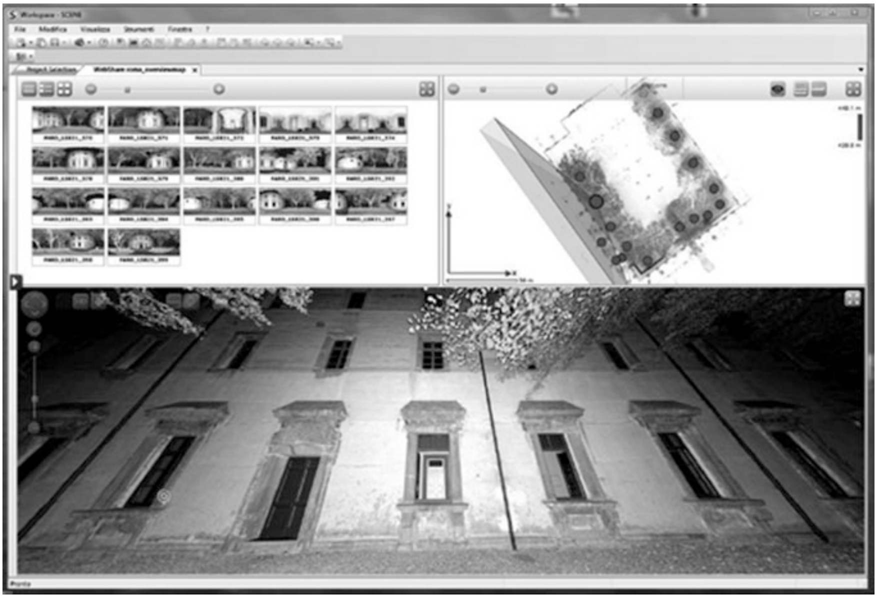

Fig. 3 *Overview map* in ambiente Faro Sene 5.1

The enforced flight program presumed the partition of the surface to be relieved—about 3.200 m^2 in total—in six parts, corresponding to the same number of flights functional to the battery lifetime. This equipment doesn't presume preliminary settings of flight standards, so speed and path were manually managed in real time.

For the survey of roofing we employed Aibotix X6 V2, a high-tech UAV weighing 3.4 kg provided, among other things, with GPS receiver, accelerometer and ultrasounds sensors. It can reaches the speed of 50 km/h and an altitude of 3 thousands meters in optimal environmental conditions. The digital camera fixed on the bridge was Olympus E-PL5, a mirrorless with CCD sensor and a resolution of 17.2 megapixels weighing about 450 g. Flight path was planned and defined within AiPro Flight software and 278 high-resolution photo shots were made, with more than 80% overlapping surface between shoots at a flight altitude of about 60 m above the ground, covering an area of about 1.6 ha including, besides the roofing object of this case study, others fields contiguous to the factory: Terrazzone, Giardino della Girandola and the esedra with embankment above (Figs. 4 and 5; Table 2).

For the survey of roofing we employed Aibotix X6 V2, a high-tech UAV weighing 3.4 kg provided, among other things, with GPS receiver, accelerometer and ultrasounds sensors. It can reaches the speed of 50 km/h and an altitude of 3 thousands meters in optimal environmental conditions. The digital camera fixed on the bridge was Olympus E-PL5, a mirrorless with CCD sensor and a resolution of 17.2 megapixels weighing about 450 g. Flight path was planned and defined within AiPro Flight software and 278 high-resolution photo shots were made, with more than 80% overlapping surface between shoots at a flight altitude of about 60 m

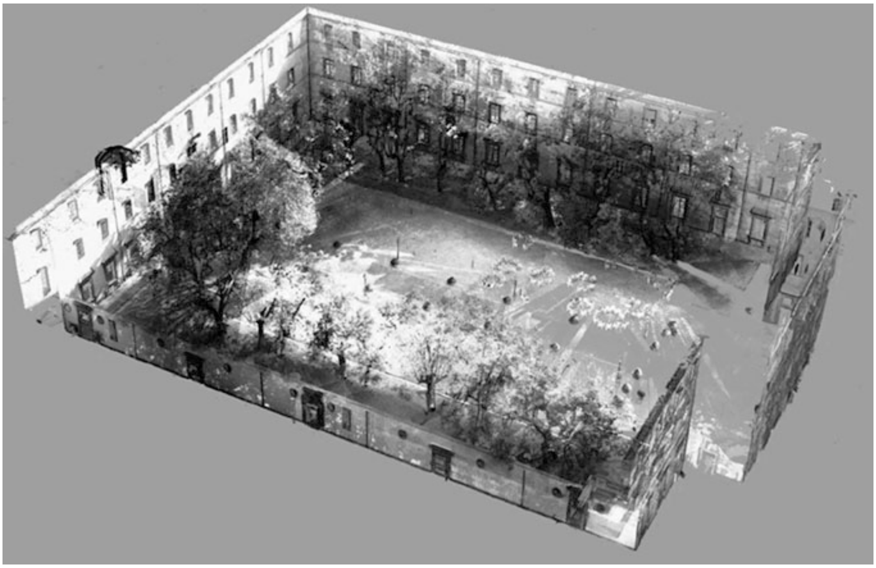

Fig. 4 Piazzale Maggiore point cloud model obtained by terrestrial laser scanning

Fig. 5 Flight program (*top*), drone DJIA2 provided with GoPro Hero 3+ (*on the bottom left*), flight path (*on the bottom right*)

above the ground, covering an area of about 1.6 ha including, besides the roofing object of this case study, others fields contiguous to the factory: Terrazzone, Giardino della Girandola and the esedra with embankment above.

Table 2 Photo/video camera settings

	Ambiti	
	External facade (GoPro Hero 3+)	Roofs + gardens (Olympus E-PL5)
Resolution (mpx)	2.0	16.1
Involved surface (sq)	3,200	16,000
Speed (mt/s.)	0.5	1
Flight duration (min.)	42	12
Number of pictures	2,200	278

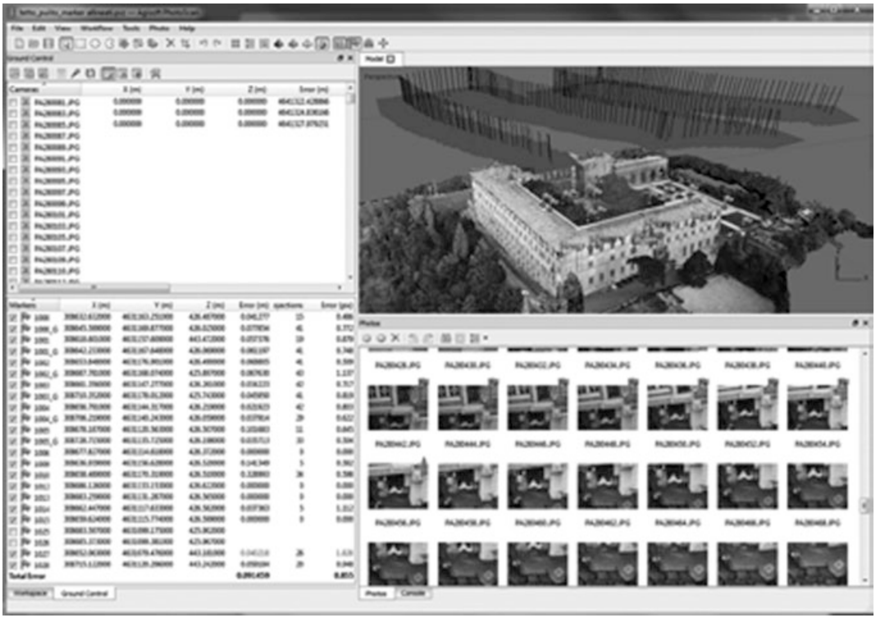

Fig. 6 Pre-alignment of photo shoots implemented by topographic footholds in Agisoft PhotoScan

Digital point cloud model of these architectonical emergencies previously shot was obtained in Agisoft PhotoScan software. In order to ensure the real structure of 3D infographic model the coordinates of topographic footholds, revealed in situ with total station and GPS, were linked to the respective points situated on raster images.

The alignment operation was made in a fully automatic way during the preliminary phase; later, to calibrate those shoots that pointed out some unacceptable alignment mistakes we proceeded with the individuation, frame by frame, of at least two pairs of homologous points which allowed to obtain a point cloud of the external façade of Manica Lunga and the entire roofing of Villa Mondragone (Figs. 6 and 7).

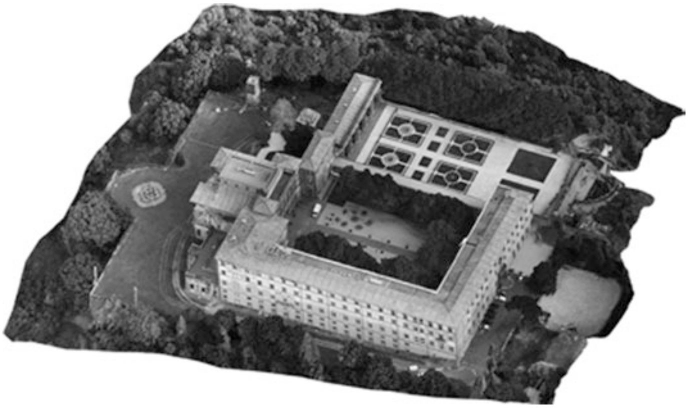

Fig. 7 Point cloud model obtained by aerial digital photogrammetry

3 Philological Reconstruction of Manica Lunga Lost Facies

Thanks to the analysis of historic documentation found (surveys, drawings, photos, postcards, etc.), the study of bibliography about this theme and, above all, the elaboration and interpretation of digital model (Cardone and Giordano 2011) of the survey obtained using those modern acquisition technologies already mentioned, the internal fronts of Manica Lunga and southern arm were reconstructed in their appearance as it should have been before 1929, more precisely in 1865.

Once 3D infographic point cloud model of the enlargements—dating back to the beginning of last century—was realized, it was possible to obtain, among other things, longitudinal sections on the buildings where they are currently incorporated. This sections, led inside the added corridors and oriented towards the ancient fronts on the Court, have been very useful for the formulation of reconstructing hypothesis, as we will see soon. Furthermore, photogrammetric survey of Manica Lunga external façade (not interested by Busiri Vici's restoration works) had a great importance during these studies, because it gave back the orthophotograph in its real form employed to study the composition of the façade, also proper of symmetric internal façade lost in 1929.

At first sight, the realization of Piazzale Maggiore new volumes caused, in this wide (and wooded) internal Court, the loss of the only curved window of Villa; vertical rows of openings on Manica Lunga façade were reduced from 14 to 13 and from 16 to 12 on southern arm front, with the loss of the ancient organization as you can see, partially and with the proper precautions, in Fig. 8. The majority of windows dating back to the end of nineteenth century were obviously transformed in connecting doors with new volumes, while others were stopped up (especially on first floor). Besides, Busiri Vici created on the façade an axis of symmetry, missing in 1865, and highlighted both by transferring one of the twin front-doors, originally situated on south-western corner of the Court in a more central position and putting two new doors at the end of the front.

Little distinguishable interventions run by Busiri Vici in 1929, misled some authors whose generically talked about modernizations (Franck 1956), collocated the volumes of 1929 in other eras (Belli Barsali and Branchetti 1975) or didn't even spot the disfigurements of distribution of empty indicated by the roman engineer-architect (Marcucci and Torresi 1987). This allows us to say that these last transformations realized in Villa Mondragone, a fifteen-seventeenth century majestic structure, seem not to be very careful towards its historic-architectonic original dignity. In this essay we focused on one of several alterations undergone by Villa less than a century ago: analyzing just one of them, we can assert that among the most efficient tools used to read in a philological and critical way the transformations realized on a factory, the most important are virtual reconstructions, obtained thanks to scientific methods pertaining to the survey field (Fig. 9).

On the basis of the results obtained, it was also possible a historic virtual tour concerning Piazzale Maggiore of Villa—of which some frames are reported—obtained by 3D modeling (in 3D Studio Max environment) of philologically reconstructed fronts (Picture 10).

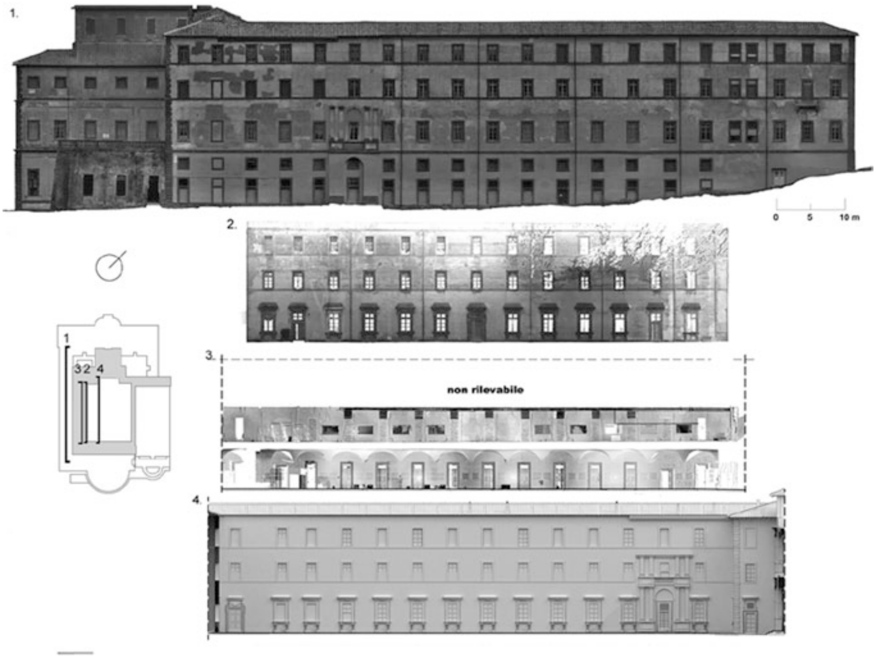

Fig. 8 Graphic arts made for the analysis of Manica Lunga internal façade: *1* orthophotograph of internal façade obtained by aerial photogrammetry; *2* current internal front obtained by laser scanning; *3* longitudinal section passing through the enlargement and oriented towards the ancient front obtained by 3D point cloud model; *4* 3D philological reconstruction of lost *facies*

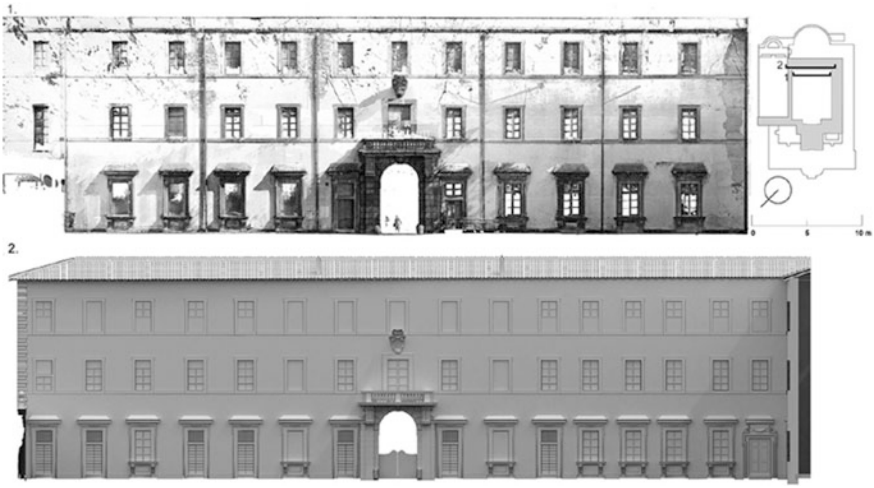

Fig. 9 Graphic arts made for the analysis of internal façade of southern arm: *1* current front obtained by laser scanning; *2* 3D philological reconstruction of lost *facies*

Picture 10 Frames obtained by *historic* virtual tour of Piazzale Maggiore

4 Conclusions

Three-dimensional survey of the environments of Manica Lunga, southern arm and the façades adjacent to them—overlooking both Piazzale Maggiore and Villa exterior—built at the beginning of twentieth century, provided interesting food for thoughts and reflections (both methodological and technological) about the issue of philological reconstruction of Villa Mondragone lost *facies*. The reading of reconstructive graphic models proposed allowed an easier comprehension of some of the transformations realized on this building complex, impossible without the essential support of the analysis and interpretation of iconographic proofs and archive documents found (Centofanti and Brusaporci 2012).

In many cases, the acquisition technologies of metric and colorimetric data for the survey of the building—of the environment too—deeply influenced technique-researcher's modus operandi and the disciplinary training related to it, thanks to the considerable reduction of measuring time in situ, the precision and accuracy of acquired data and, above all, the transformation of the survey from punctual to continuous, transferring delicate operation of discretization of the object during the acquisition phase in loco to the following drafting of graphic outputs (Barba et al. 2012). Nevertheless, an infographic 3D model (point cloud) re-proposing, with an absolute scientific fidelity, morphological and colorimetrical characteristics of the building analyzed represents a powerful tool that the researcher—the engineer or the architect (for eventual technical aspects of planning)—can consult in any moment for his considerations and evaluating research.

The increasing practicality offered by this tools can however lead to the risk of reducing the survey in a series of mechanical and standardized operations and to consider photogrammetry and laser scanning "ideal" methodologies (Russo and Remondino 2012). But the technique has to be able to read architectural morphology of the factory—or, depending on the cases, of urban and country fields—, and to rule these new technologies separating the method from the technique, being clear to him the aims of the survey, analyzing contexts, planning operations and calibrating, step by step, tools settings in order to obtain valiant results through an efficient management of data that often seem redundant and could be inefficient.

This kind of survey methodology could be used for other monumental situations becoming a valiant tool for correct reading of historic stratification. Digital reproducibility of an artifact, then, can be translated into multiple development opportunities also for those areas related to protection and enhancement.

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The First Views of Malaga in the 16th Century: Graphic Sources for Research

Antonio Gámiz Gordo and Luis Ruiz Padrón

Abstract Architecture and urban planning should contribute to urban progress by preserving the fragile values of inherited landscapes, integrating the old and the new. It is thus essential to investigate the transformations of each site has undergone, using graphic sources and checking their reliability. The case of the first views of Malaga in the 16th century is discussed here. Apart from reviewing symbolic representations of little documentary value, the views drawn by Anton van den Wyngaerde in 1564 and the one published in Civitates Orbis Terrarum in 1572 are analyzed; all of which provide exceptional testimonies of a landscape transformed through the centuries.

Keywords Málaga · Wyngaerde · Civitates

1 General Considerations

The image of the city of Malaga has been marked from the outset by the sea, its port and the Penibetica ridge as a backdrop. For centuries the massive volume of the Cathedral has been a silhouette on the skyline, above the town, its towers and walls. To the east stands the hill of Gibralfaro, crowned by the fortress of the same name, and somewhat below, the Alcazaba, considered to be one of the finest examples of its kind still standing (Torres Balbás 1982).

Except for the dominant presence of the Gibralfaro and Alcazaba, today it is difficult to recognize the city scape captured in views from the past. The Cathedral is now almost hidden among buildings of considerable height. The port infrastructures, which form the main facade of the city, present a very different character

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from old pictures. In addition, over the past decade a new seafront has sprung up, quite close to the ancient city core.

Typically, as it has been the case in many urban development plans nowadays, the current Special Plan of Protection and Interior Reform (PEPRI) for the centre of Malaga considers the development of the city in two dimensions only, basically from floorplans. The plan seems to show a lack of understanding of the city's three-dimensional form and appearance, therefore this research work stresses the need to investigate the visual or perceptual values of the urban landscape, which so much affect our collective memory. This article tries to open a reflection on the evolution of the image of Malaga, based on its first images from the 16th century, in particular the views of Anton van den Wyngaerde and the one included in the Civitates Orbis Terrarum, which is often attributed to Joris Hoefnagel. These drawings are representative of the curiosity of the time to learn about the cities of the world, and their surroundings.

In an enclave such as Malaga, whose evolution has been so linked to its port activities, it is necessary to consider works such as the one by Cabrera Pablos (1994), in which he compiles important plans and drawings of the port and its fortifications. Equally interesting are the studies of Calero Secall and Martínez Enamorado (1995) which bring us back to the city through Arab written sources; while Ruiz Povedano (2000) addresses the urban development of Malaga in the 15th and 16th centuries. Also noteworthy is the approximation to the shape of the built city and its evolution over time by Machuca Santa-Cruz (1987).

However, very few studies have addressed Malaga as a townscape throughout history, with exceptions such those of Sauret (1991) and García Gómez (1995). Among the studies on images of Malaga a pioneering publication was directed by Kagan (1986), which analyzed all Spanish views by Wyngaerde, identifying its main urban elements. The graphic work of the artist was the subject of a comprehensive bibliographic work by Galera i Monegal (1998). Also, Gil Sanjuán and Pérez de Colosía Rodríguez (1997) have commented the views by Wyngaerde and the one from the Civitates of Malaga, among other images from the Kingdom of Granada.

It must be taken into consideration that until the 16th century cityscapes were very few, and their character was of the symbolic kind, having little real, documentary value. The 16th century, therefore, marks the beginnings of a graphic history of Malaga and its landscape. The city would have then showed a marked medieval character, but was already immersed in projects that would last for centuries, such as the port and the Cathedral, central to the city's graphic identity ever since.

With respect to the analysis methodology used, the urban elements portrayed in the views have been identified first, and then they have been located in a current city plan. Then according to their relative position, the approximate location from which they were drawn has been determined. The location of the vantage points and the estimated cone of vision in each case has been central to establishing a dialogue with other images from the past.

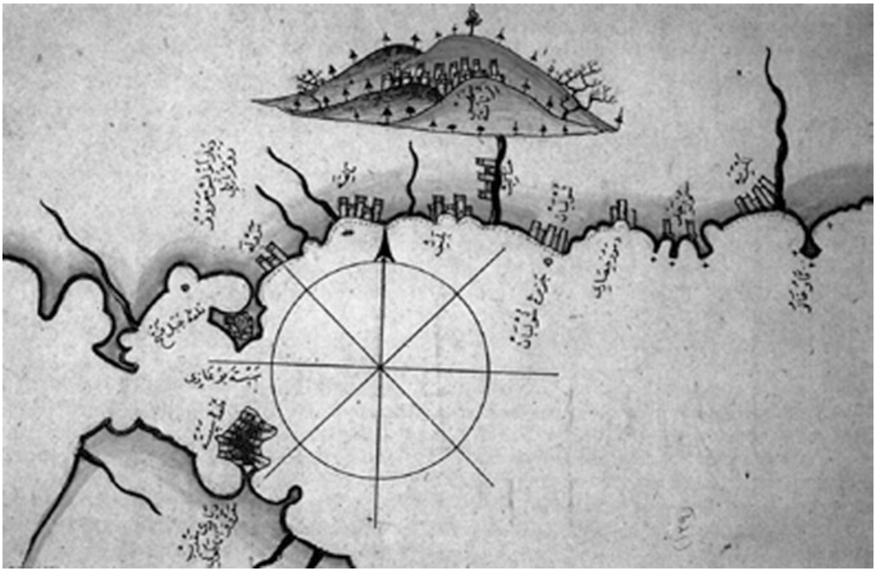

Fig. 1 Piri Reis, h. 1517–1528: Andalusian Mediterranean coast

Once the vantage point had been located, and due to the unusual expanse of the panoramic views by Wyngaerde, attention has been given to the degree of distortion—and possible methods of visual correction—used by the artist. In the proposed mapping, the main view has been redrawn for ease of understanding, also for the cataloging of urban elements and the comparison with other views. Also possible mistakes, omissions and inconsistencies have been investigated, always keeping the purposes of each drawing in mind.

To assess the documentary interest of historical views of cities, it is of key importance to address its reliability, an issue which logically does not arise in photographic views. In some studies on the artists discussed here reliability has been taken for granted, perhaps thoughtlessly. The graphic work by Wyngaerde has been described as "devoid of fantasy, close to scientific representation", talking even about "mathematical accuracy" (Maderuelo 2005, 279). In the case of Malaga Wyngaerde has been praised as "main surveyor of his time" as opposed to the "little attention [that in drawings of Hoefnagel] is given to the perspective nor the scale" (Kagan 1986, 225) and his views as "a perfect topographical layout" (Gil Sanjuán and Pérez de Colosía Rodríguez 1997, 243).

Such statements are not consistent with the opinion of other researchers who have analyzed the graphic process followed by Wyngaerde, which implies taking partial drawings on the spot and then assembling them into final views. In the case of Valencia, "the result [the final panorama] is a construction based on multiple viewpoints that accumulate dispersed information and lack of visual consistency […] The idea of systematic […] does not exist, despite the apparent perfection and accuracy of the final view …" (Marías 2002, 110). In Zaragoza "the complication of this stage [making partial drawings] is to not reach an appropriate relationship between the parts, that is, that they express the fragmented nature of the compositional process" (Arévalo Rodríguez 2003, 195). Civitates' own engraver, Franz Hogenberg, said that sometimes "the real perception of the city is manipulated to further the understanding of it as a whole" (Goss 1992, 5).

In this sense, the intention has been to assess the reliability of the views of Malaga from the 16th century as graphic sources to research its cityscape. A work already done for other cities, but pending in the case of Malaga, where certain clarifications seem necessary.

In addition, the importance of the historical context of the aforementioned drawings should be stressed. In the second half of the 16th century the Spanish monarchy was involved in various feats of arms: Tunisia (1535), Djerba (1560), Peñon de Velez de la Gomera (1564), Malta (1565), Tunisia (again in 1573) which placed Malaga and its port at the epicenter of conflict, not to mention the rebellion of the Alpujarras (1568). From Malaga daily supplies departed, including water, for the Spanish forts in the African coast. All this would promote the new port project, whose works began in 1588 by order of Philip II. It should not be forgotten that Wyngaerde made his drawings in Malaga while on the way, as a "graphic war correspondent", to Peñon de Velez de la Gomera in 1564, and that those drawings were most likely seen by the king himself.

The commission would determine the decisions made in each drawing, their vantage points, selected information, etc. But also the sensitivity and ability of each artist must be taken into account in order to interpret the character of each place, highlighting certain elements above others. In this regard, the representation of characters or human activities favored the depiction of a more credible scenario, thus rooting the image in a particular space and time.

All this can be linked to the references made in the preceding paragraphs to the document of the Preservation Plan for the City Centre in Malaga, on the consideration of the worth of the urban landscape in drafting new projects. Graphic research on the city and its landscape over time is needed, in order to provide the adequate knowledge and background for any proposed urban development.

2 First Symbolic Representations of the City of Malaga

Although the first realistic images of Malaga were drawn in the second half of the 16th century, some earlier cartographic representations should be mentioned, such as nautical charts or the so called 'portulanos', arising from the 13th century with the improvement of navigation in the Mediterranean. In them the relative importance of different cities can be seen, sometimes symbolized by idealized buildings. Some examples are preserved in the National Library in Paris, such as the chart of Angelino Dulcert (1339) or the Catalan Atlas of Abraham and Jafuda Cresques (1375). Some maps of the Turkish cartographer Piri Reis must be also cited, these are (?–1553) held today in the Topka pi Museum in Istanbul, and include symbolic views of Malaga and other cities of the Kingdom of Granada (Fig. 1).

Also worth of mentioning are the representations of Andalusia based on the work of the astronomer and geographer Claudius Ptolemy in the second century, subject of several copies until the 1 century. In other maps, like the one by the cartographer Giacomo Gastaldi (1544), Malaga was drawn symbolically in the center of its bay.

Other significant historic imagery include carvings in the backs of the stalls in Toledo Cathedral by Rodrigo Alemán between 1489 and 1495 (Carriazo 1985), which represent, in an idealized way, the conquering of more than 40 towns in the Kingdom of Granada. In the case of Malaga, the assassination attempt perpetrated against the Catholic Monarchs in their tents during the siege of Malaga is depicted in one of the stalls, and Christian troops entering the city, in another (Fig. 2).

A series of tapestries commemorating the conquest of Tunis in 1535 by Emperor Charles I, woven in Brussels between 1548 and 1554, should also be mentioned. They were developed from sketches by Cornelisz Vermeyen and Pieter Coecke van Aelst. Copies of which, from the 18th century are preserved at the Real Alcazar de Sevilla. They depict with some cartographic rigor feats of arms in which Malaga had a leading role, although the representation of the city itself is symbolic.

From the time of Philip II there are two important collections of city views of huge documentary value, for how thoroughly their details were drawn, which in the case of Malaga will be commented in the following paragraphs.

Fig. 2 Rodrigo Alemán, h. 1489–1495: Relief in choir stalls of the Cathedral of Toledo; the surrender of the city of Malaga

3 The Views of Malaga by Wyngaerde

Four drawings by Anton van der Wyngaerde on the city of Malaga are known: two sketches, a preparatory view and a final panoramic view.

A small sketch (8 × 15.5 cm) representing the current Constitution Square, is preserved at the National Library in Vienna. This space looks very different today, but a plan from 1571 held at the Municipal Archives of Malaga allows its identification (Barrionuevo Serrano and Mairal Jiménez 2007) (Fig. 3).

Another ink drawing (20.5 × 28.5 cm) is preserved at the Victoria and Albert Museum in London which shows the fortified complex of Gibralfaro. This is an outline that bears little connection with reality: the walled perimeters have been simplified and at the coracha some towers have been drawn that do not exist in reality. Although Kagan (1986, 220) indicates that it may be a sketch from nature, the bird's eye view of the enclosures discard such hypothesis (Fig. 4).

A preparatory drawing view in ink (15.5 × 106.5 cm) is preserved at the National Library in Vienna. The vista stretches from Cantal Point to Torremolinos Point. From the elements depicted it can be deduced that it was drawn from the Corral de la Alcazaba, an element that was replaced in the 18th century by the Customs Palace. Actually, it is an assembly of two views looking in opposite directions from the same point, covering a visual cone of about 330°, in such a way that the horizon of the sea unifies the scene. To the left, the start of the Camino de Vélez appears at the foot of Mount Gibralfaro and to the right, the city at roof level. On the sea there are two large vessels and a note on the number of ships, "26". To be highlighted is the absence of the cathedral, whose apse should appear in the

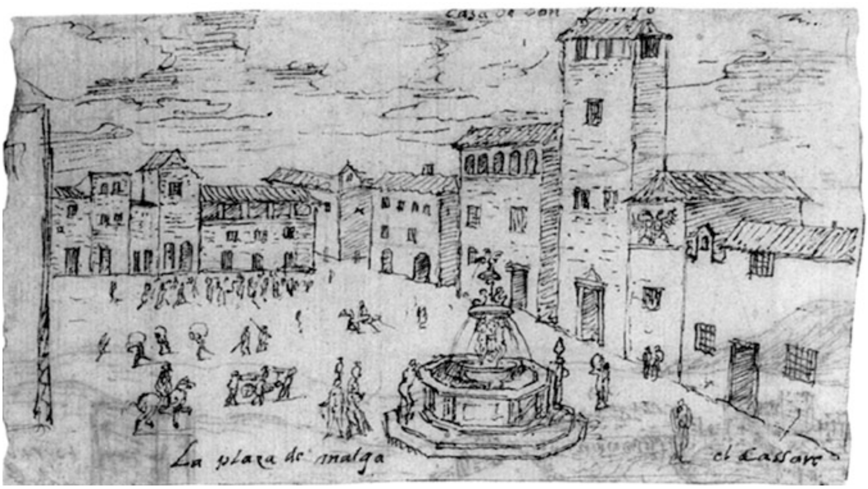

Fig. 3 Anton van den Wyngaerde, 1564: Sketch of the now called Constitution Square (Malaga)

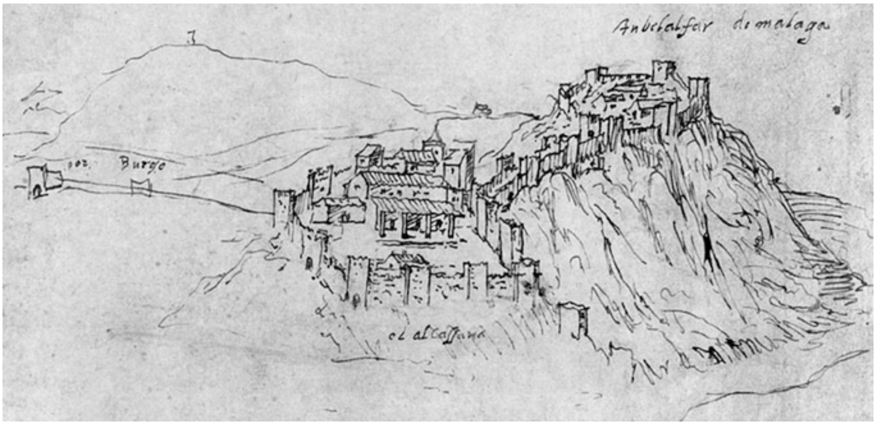

Fig. 4 Anton van den Wyngaerde, 1564: Sketch of Gibralfaro

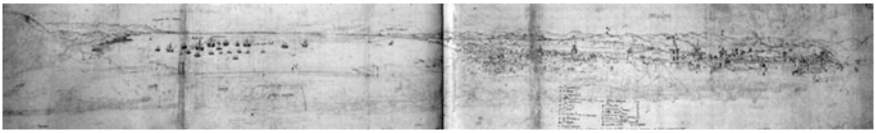

Fig. 5 Anton van den Wyngaerde, 1564: Preparatory sketch view from the Corral de la Alcazaba

foreground near the note "the incarnation of Santa maria glesia Magior" but in that assembly of the two views the legend "Magior glesia" appears. In other words, the Cathedral seems to 'be' in two places without being drawn (Fig. 5).

The final panorama in ink and color (26 × 108 cm), preserved in the Ashmolean Museum in Oxford, shows the city from a fictional vantage point above the sea, covering a range of about 210°, from the Torremolinos Point to the Caleta Beach. It is orientated towards the Puerta del Mar, where troops are assembled and boats are drawn carrying soldiers to the ships at anchor in the cove. In the foreground there is the seafront of Malaga, the rising walls of the cathedral and the Alcazaba Gibralfaro complex can be seen together with the walls. Fortified city elements are drawn with precision, with greater intensity in the tone of the ink, while the rest of the drawing ink is more tenuous. Surrounding the urban area, the gardens and orchards that made the city famous—according to Arab chroniclers– can be seen, with mountains in the background (Fig. 6).

Comparing the final panorama with the preparatory drawing, it is found that the elements shown (churches, towers, convents, palaces, mountains …) nearly coincide, although the preparatory drawing is more accurate. We are not in front of an earlier draft for another final unpreserved view, as suggested by Kagan (1986, 220), moreover, the skyline in the final view was copied from the preparatory drawing

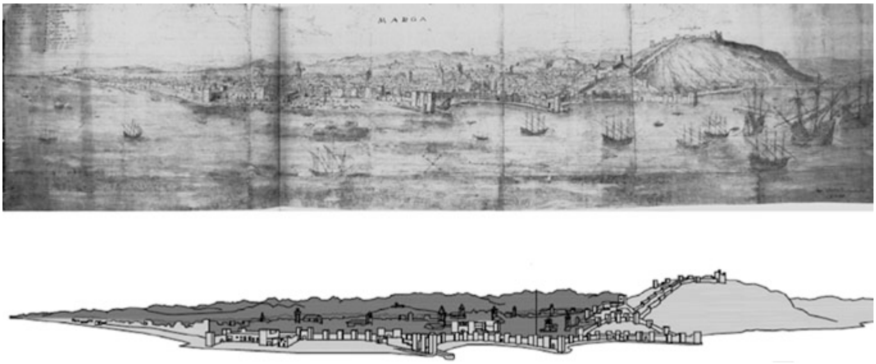

Fig. 6 Anton van den Wyngaerde, 1564: Final view from the sea (*above*). Luis Ruiz Padrón, 2012: Chart on the assembly of preparatory drawing and final panoramic views (*below*)

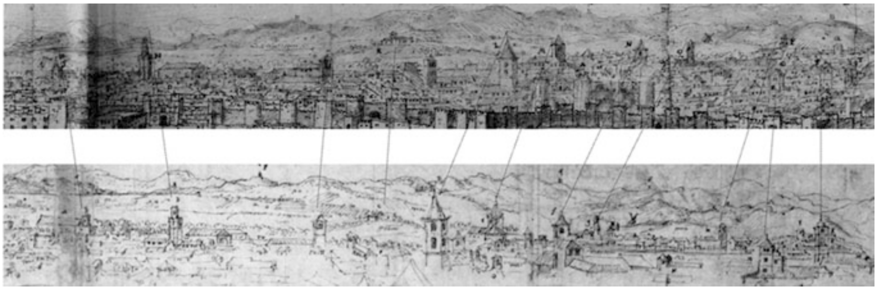

Fig. 7 Anton van den Wyngaerde, 1564: Comparison of fragments transferred to the final view (*above*) from the preparatory drawing view (*below*)

with virtually no alterations (Ruiz Padrón 2016). In other words, this is a surprising assembly of drawings with distinct vantage points. After drawing excellent closeups from the sea, Wyngaerde completed the view just copying his drawing from the Alcazaba, from where the inner city is best seen, applying corrections to convert the perspective into an eloquent bird's eye view. This explains the plausibility of the details drawn and the major inconsistencies in their relative position (Fig. 7).

4 The View from Civitates Orbis Terrarum

Another important view of Malaga from the 16th century is part of a large atlas with more than 500 views of towns, known as Civitates Orbis Terrarum, edited by canon George Braun together with the engraver Franz Hogenberg in 6 volumes published between 1572 and 1617, with editions in Latin, French and German (Gámiz Gordo 2008, 60). Joris Hoefnagel (1542–1600) was the author of many of the 43 views of

Spain, drawn between 1563 and 1567, as follows from the plates, although many are not signed or dated. Among them, the view of the Peñon de Velez de la Gomera could be based on drawings by Wyngaerde, which documented the military events that took place there.

Volume I (1572) includes an oblong plate with three views: at the top Seville, at the centre Cadiz and at the bottom Malaga (11.8 × 47.8 cm each). It cannot be ruled out that the Malaga view, undated and unsigned, was drawn by Wyngaerde, although it has been often attributed to Hoefnagel, who could have accompanied him on his trip; as seen in other of his views where two characters appear, maybe themselves. It should be taken into consideration that in the National Library in Vienna, the drawings by Wyngaerde and the originals after which the plates of the Civitates were made including the original one for Malaga—have been preserved in the same folder.

The vantage point is situated on the coast, west of the city center. With a visual cone of about 75°, the view is headed towards Gibralfaro and Alcazaba, both quite accurately detailed. Unfortunately, it is not possible to enjoy this view nowadays since the place is situated in one of the most densely built districts of Malaga.

In the foreground is the Tower of Fonseca, adjoining the Carmelite convent in front of the suburb of Perchel. Behind lies the walled city with the mountains at the background, and the bay quite well depicted. In other words, it reflects quite clearly the port city and its fortifications in connection with the territory. However it is not possible to see inside the walled city, and since it is a side view of the waterfront, relevant details are omitted, as the facade of the shipyards or the old customs building. The Puerta del Mar would also be hidden from here, but given its importance, the artist decided to include it, moving and turning it towards the observer.

Actually, this image contains multiple horizons. On the left, the seafront of the neighborhood of Perchel is drawn up to the human eye level. Behind the walled city nucleus appears, but at the so called Torre Gorda the perspective changes, the height of the vantage point is raised and the ground plane is tilted toward the observer. The same has been done with the view of the coast looking east, as the succession of coves that characterize it is detailed, instead of the simple horizontal line that should be perceived there.

Interestingly, unlike Hoefnagal's other views of cities, folk scenes are not depicted in the foreground (Gil Sanjuán and Pérez de Colosía Rodríguez 1997) which suggests the possible authorship of Wyngaerde. On the beach of San Andrés fishing vessels do appear, and on the sea also caravels, pataches, galleons and a fleet of ten galleys, which give an idea of the importance of the port of Malaga (Fig. 8).

5 Conclusions

After studying the first views of Malaga in the 16th century in terms of design and development, it should be noted the happy coincidence between the historical moment in which the drawings were made and the beginning of major urban

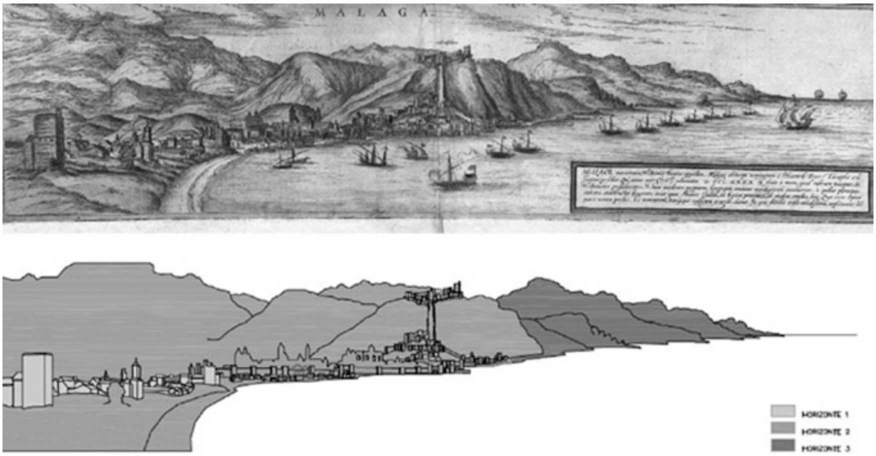

Fig. 8 View of Malaga published in the Civitates Orbis Terrarum, 1572 (*above*). Luis Ruiz Padrón, 2012: scheme on parts of the view with different horizons (*below*)

transformations that have continued up to the present time. We are in front of graphic sources of great value for research, which illustrate changes and permanences in the cityscape of Malaga, providing data on many urban elements ranging from infrastructure to buildings, spaces and architectural landmarks of the city.

For proper interpretation of these graphic sources, its credibility or reliability has been assessed, according to their preparative processes. Regarding the views by Wyngaerde, the sketch of the current Constitution Square lets us know its condition at the time as analyzed together with a map from 1571, while, conversely the view of Gibralfaro from the air has little credibility, not being a sketch made on the spot. However, the drawing from the Alcazaba provides reliable details of highest interest. And the spectacular view from the sea offers precise foreground of the wall, although the walled city is an amazing assembly where the described drawing taken from the distant Alcazaba is inserted albeit with a different orientation. Therefore, systematic praises on the drawings by Wyngaerde should be set aside; those are generally magnificent and reliable, but not in every case.

As for the drawing from the Civitates, it covers a smaller cone of vision but it offers a realistic view of the city and its surroundings, with certain graphic license. In any case it seems appropriate to jointly study the views of Wyngaerde and the one from the Civitates, considering their context and possible relationships that raise questions about the authorship so far attributed to Hoefnagel (Fig. 9).

The analysis of views finally suggested taking photos or drawings from the current location where they were taken in the 16th century. In the case of Wyngaerde, it is not possible to stand today in the yard of the Alcazaba, as it disappeared in the 18th century, but it has been feasible a to take one picture close to the imaginary view from the sea from the cover of the current port warehouses of

Fig. 9 Luis Ruiz Padrón, 2012: cones of vision and urban elements in the views of Wyngaerde and Civitates on schematic plan of Malaga in the 16th century

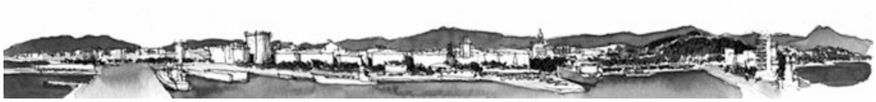

Fig. 10 Luis Ruiz Padrón, 2012: Malaga from a vantage point close to the one in the view by Wyngaerde

Goliat Cement company. As for the case of the Civitates, that lonely beach has become, today, a popular neighborhood with its tall buildings blocking any possible view of the older city (Fig. 10).

It is expected that these images, along with many of those of Malaga produced throughout his prolific graphic story (Ruiz Padrón 2016), can contribute to a more effective urban planning that is responsive to the perception and enjoyment of Malaga's visual identity, integrating its past with its future.

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Graphical Analysis of the Landscape in and Around the San Francisco de Borja Fontilles Sanatorium

José Luis Higón Calvet, Jorge Llopis Verdú, Javier Pérez Igualada, Pedro Cabezos Bernal, Jorge Martínez Piqueras and Ignacio Cabodevilla-Artieda

Abstract San Francisco de Borja's Sanatorium of Fontilles was founded in 1905 for the treatment of leprosy. In its current configuration, the Sanatorium consists of a set of 29 buildings from different ages and styles. This large heritage has been promoted to join the *International Coalition of Historic Sites of Exclusion and Resistance* project, and aims to declare it as Heritage Site by UNESCO. The graphical analysis allows the definition of the set and the characterization of landscape, as a previous step to the formulation of a '*Landscape Program*' that articulates the set of measures and actions in order to preserve, improve and enhance the outstanding quality of the set.

Keywords Graphical analysis · Landscape interpretation · Digital model elevation

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1 Introduction

Within the framework of the rich architectural tradition that caters to the needs of medicine, there is a very singular case, namely the treatment of infectious diseases. They were hospital complexes that called for the complete isolation of the patients, the only guarantee to stop the propagation of the diseases, and with no hope of patients being cured, were synonymous with strong social rejection. One of the most extreme cases since these hospital complexes used to isolate patients with an incurable illness were created was leprosy.

The isolation strategy, seen as the only way to eradicate the disease and avoid it spreading throughout the endemic areas, continued through until the end of the 19th century (Alcaide González and Rafael 1999; Bonastra Tolás and Joaquim 2006). Even in 1909, at the Second International Leprosy Congress held in Bergen, it was recommended that through segregation, children should be separated from their leper parents as early as possible. The suggestion was to isolate the ill in specific areas, the underlying directive being to isolate as far as possible an incurable disease, providing patients with basic levels of hygiene and healthcare, while at the same time establishing social structures and creating microsocieties where patients would be able to live a life that was as close to normality as possible.

This is the case of places like the San Francisco de Borja Fontilles Sanatorium in Spain, surrounded by the ever-present boundary wall, not to mark the limitations of the complex, but rather to stop patients from leaving and cut them off from having any interaction with the outside world. This was also true for Spinalonga Island, located on a former Venetian island fortress or the *Leprosario Nacional de Rovisco Pais* (Portugal), and located in the middle of an isolated forest.

Once a cure was found for the disease, these sites went into a slow decline, which at times resulted in the complex being fully abandoned, and in the case of Spinalonga Island, it led to the whole of the residential building disappearing completely. Elsewhere, in sites such as the Fontilles Sanatorium, the buildings have lasted the test of time, and continue to be used as was their original purpose within the framework of development cooperation programmes, applying their experience and expertise in countries where diseases that lead to social exclusion and are associated with poverty are still quite prevalent.

This is why in 2012, an initiative was launched to draw attention to these spaces and to promote, disseminate and preserve them. The *International Coalition of Historic Sites of Exclusion and Resistance*,[1] organised by the IDEA (*International Association for Integration, Dignity and Economic Advancement*),[2] the aim of which is to create and international network of leprosy heritage sites; sites that are

[1]The International Coalition of Historic Sites of Exclusion and Resistance promotes the recovery and promotion of sites of exclusion http://www.leprosyheritage.com/.

[2]The IDEA (*International Association for Integration*, *Dignity and Economic Advancement*) is an advisory Non-Governmental Organization of the UN Economic and Social Council (ONG) http://www.idealeprosydignity.org/.

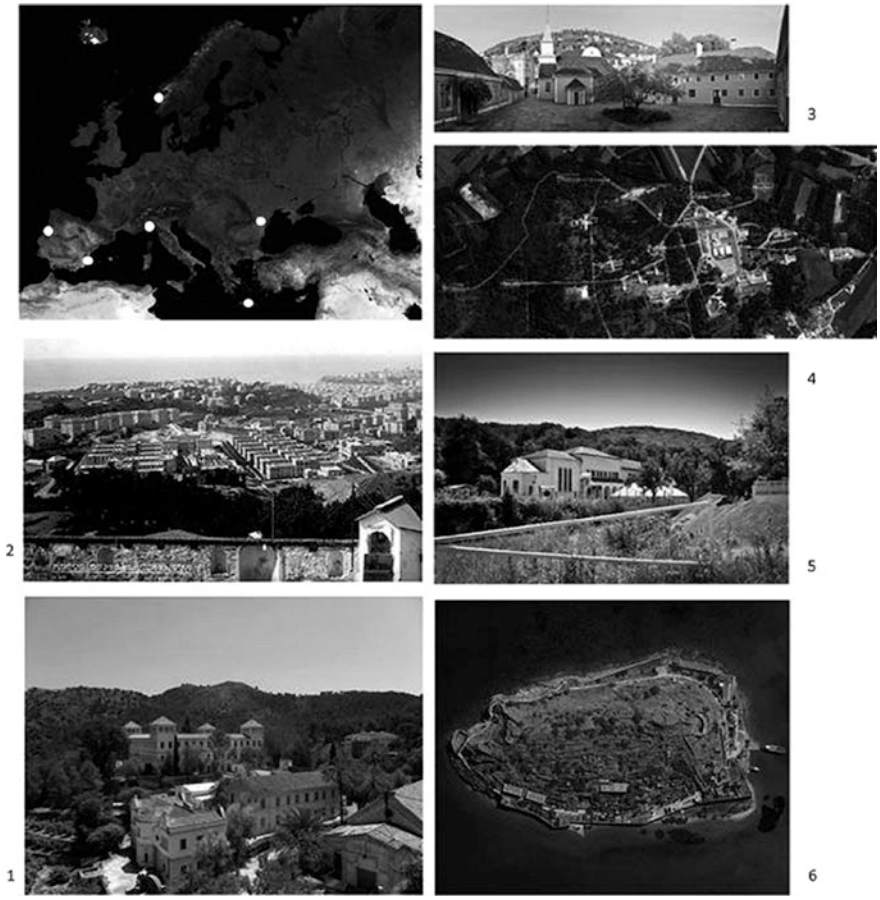

Fig. 1 Leprosy heritage sites in Europe: *1* Fontilles Sanatorium (Spain); *2* San Martino Leprosy Hospital in Genoa (Italy); *3* St. Jørgen Hospital in Bergen (Norway); *4* Leprosaria Nacional Rovisco Pais (Portugal); *5* Tichilesti Leper Hospital (Rumania); *6* Spinalonga Island in Crete (Greece)

characterised by their importance in getting an overall understanding of this phenomenon, and whose specific heritage assets enables us to appreciate their importance as sites that warrant being declared a UNESCO World Heritage Sites. Currently, the *International Coalition of Historic Sites of Exclusion and Resistance*, has identified more than 100 sites in 60 countries, 18 of them, 5 of which are in Europe, are considered significant at a global level (Figs. 1, 2).

2 The San Francisco de Borja Fontilles Sanatorium

The San Francisco de Borja Fontilles Sanatorium comprises a set of buildings founded in 1905 to treat leprosy (Bernabeu Mestre 1991). Currently, the heritage complex in Fontilles comprises a total of 29 buildings from different time periods and architectural styles, even though the number and the purpose for which the buildings were used have undergone a number of changes since it was first opened over a century ago, with a variety of different demolition and rebuilding activities, and this gradually changed the architectural configuration and how it blended into the landscape.

The hygienic and climatic conditions that this site and its buildings should comply with according to medical experts should be as follows: located in dry areas, separated from the sea and a potential for farming land to make them self-sufficient, in addition to a fresh water supply in sufficient quantities for a new sanatorium, with a number of pavilions, a large garden area and allotments. The search for a suitable spot on which to build the complex which began in 1902, lasted just over a year, when the decision was made to build the sanatorium in an isolated valley located within the municipalities of Murla, Orba and Laguar (Chias Navarro 2013). Father Ferris, the main instigator behind the initiative, stated that "it would be difficult to find anywhere in Spain that so perfectly fits its purpose", while at the same time, praising the plant life and vegetation of the valley with its abundant water supply and wonderful views from the valley towards the sea (Bonilla 2011) (Fig. 3).

Fig. 2 San Francisco de Borja Fontilles Sanatorium. Partial view of the valley and its buildings

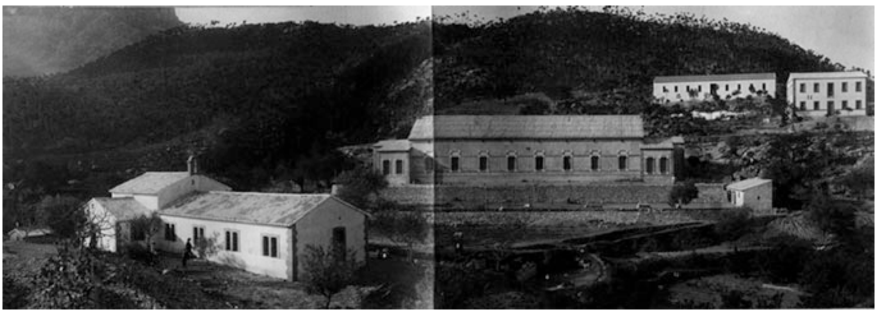

Fig. 3 The founding of Fontilles. Distribution of the blocks (approx. 1906)

The medical requirements were in line with way of thinking at that time for this type of building, namely erecting independent blocks to ensure that patients were isolated, separating patients from the staff, and the men from the women.

The first blocks were opened in 1906, but the complex underwent a constant series of expansion and renovation projects, which went practically uninterrupted until the 1960s, at which point it had acquired the look that we now see today (Pérez Igualada 2013).

3 Landscape Study of the Complex. Heritage Assets of the Landscape

The architectural sites that are part of the *International Coalition of Historic Sites of Exclusion and Resistance*, boast a rich material heritage comprising the buildings themselves plus their integration into the urban or country landscape of their surroundings.

In the case of the Fontilles Sanatorium, the modest buildings that are part of the complex acquire a different heritage dimension when they are part of a complex that is intimately linked to the surrounding area. The valley where the sanatorium is located, as seen today, is the result of process of transformational landscaping that goes far beyond the original intentions of the founders of the complex and of the original architects that shaped it (Recatalá and Sánchez 1996). It is a result of the daily activities carried out by the patients, and this desire to create for them a social environment where they could live a normal life as far as possible. The complex was conceived as a microcity to satisfy the needs of a population that was unable to leave the confines, with a church, theatre, laundry, carpentry workshop and even its own cemetery.

The hillsides and dells were turned into allotments and animal pens and were even replanted with trees to turn a Mediterranean valley of low brush into the woodlands that we see today, where in addition to the indigenous plant life, we also see araucarias. The re forestation was just another one of the jobs given to the patients, the scale of which can be seen in the words of Rafael Ferris, brother of the founder and a forestry engineer, who in 1922 said "… work continues with the tree planting, where each year sees the planting of a variety of different types of tree that are suitable for this soil. Up to now, we have planted 4000 Aleppo pines … 100 stone pines, 100 casuarinas and 100 eucalyptus … 40 strawberry trees and hundreds of rosemary shrubs around all the borders for decoration and of course, the hedge …".[3]

The research project aims to carry out a comprehensive graphical analysis of the natural surroundings and of the value of the landscape at the Fontilles Sanatorium. The location of the pavilions in the Laguar Valley was in response to both topographical criteria and the suitability of the landscape for both functional and

[3]Fontilles Magazine. January 1922, p. 2284.

sanitary reasons. The aim is to examine the architectural and structural aspects such as the sun exposure and the ventilation of the pavilions and their suitability given their particular medical requisites, as well as the more general aspects such as the spatial planning of the land, the circulation of people and how they relate to the uses and functions of the different buildings over the course of the years. The idea is to accurately define the structure of the terraces, gardens, irrigation systems and other man-made spaces, and then to generate a database containing the primary elements of the architectural and natural heritage assets of the complex (Fig. 4).

4 Implementation Strategies, Location Selection

The site where the Fontilles Sanatorium complex was set us is configured, from its access by road from the CV721, and the set of buildings that occupy the valley which can be accessed via a single road. The valley acts as an autonomous unit from the functional and visual perspective, and favours as such this type of spatial segregation from its immediate surroundings. Its proximity to the inhabited urban hubs of Orba and El Campell, is negligible due to its choice of location where spatial segregation is achieved by the topography and bolstered by the construction of a boundary wall around the complex. As for the valley where the Fontilles Sanatorium is located, there are, given its spatial enclosure, slopes in all directions, with those facing east being the steepest. This favours the position of the very first buildings of the complex, taking advantage of the east facing slopes, not only for its better topographical conditions, but also for the added advantage of receiving a direct sea breeze, as the building is east facing on the hillock and the source of the stream that flows along the valley floor (Fig. 5).

The north-south orientation of the buildings favours the reception of solar radiation on the East-West façades, while a sufficient gap between the buildings stops the shadow of one being cast over another. The graphical analysis of the exposure to sun of the valley slopes was carried out using the gvSIG_Desktop software. In order to detect areas that are excessively shady, and not suitable for the development of the hospital programme, irradiation maps were obtained using the Digital Elevation Model provided by the Valencia Cartographic Institute. The Digital Elevation Model shows the topography of the valley with a resolution of 1 point/m2. The software used produces a raster graphic in tones of greys, where the tone corresponds to the total number of hours of sun over a specific time period. In order to be able to study the exposure to sun, two different shade maps were created; one corresponding to the summer, the other to the winter.

The solar radiation maps show that during the summer, that the exposure to sun of the whole valley is acceptable, borderline excessive, given that the solar height during this period limits the amount of shadows cast by the hills that surround the valley. With the solar radiation map for the winter period, on the other hand, it can be seen that although there is a certain fall in the amount of exposure to the sun during the winter, the sun exposure conditions of the east slope, where the buildings

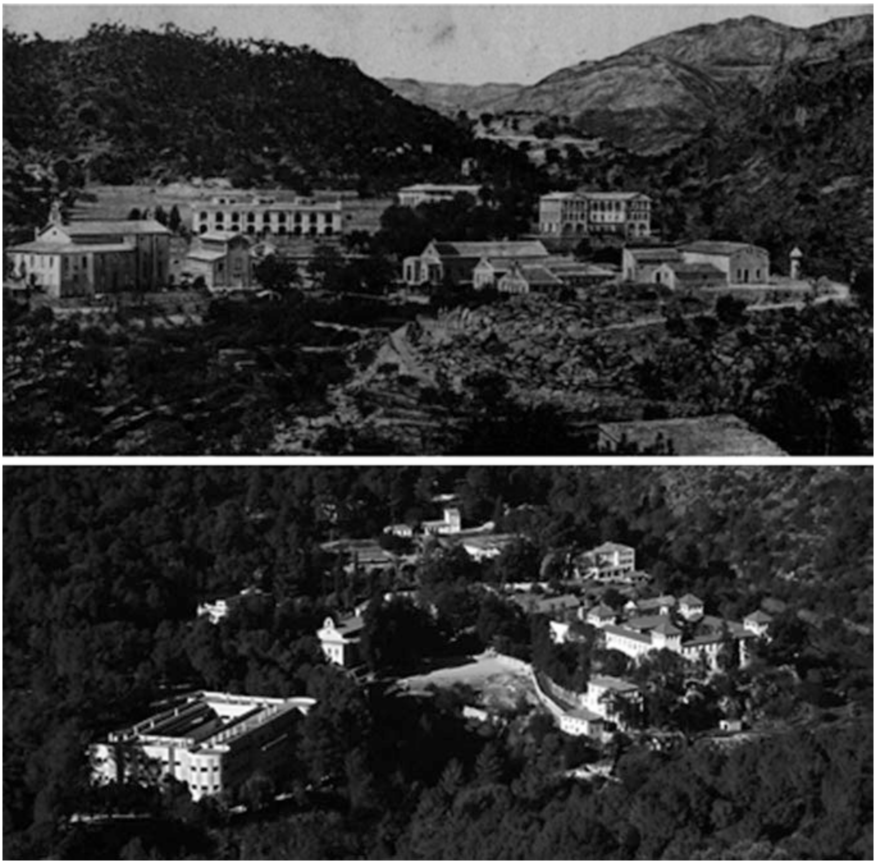

Fig. 4 The process of "landscape creation" via the transformation of the vegetation of the valley after the Fontilles Sanatorium was first founded (approx. 1920) and a present view of the valley

were constructed have values that are in keeping with the medical and hygienic requirements of the hospital programme (Fig. 6).

The original nucleus of the Fontilles Sanatorium was built on the east slope, and the buildings it comprised of; the guesthouse, the Joaquín Ballester Residence, the Laundry House, have a predominantly north-south orientation, running horizontal to the slope. As the nucleus grew, it included the building of a Church, the Theatre, the House of the Volunteer Sisters, and these new buildings were added to the original complex using mechanisms to ensure that formal and spatial continuity was maintained. These mechanisms comprised a system of paths, and the building of terraces to make the most of the farming potential of the valley.

The aim of the system of paths was to generate, as far a possible, an internal network within the complex with easily manoeuvred slopes for both vehicles and pedestrians, giving a certain unity to the complex, interconnecting all the buildings,

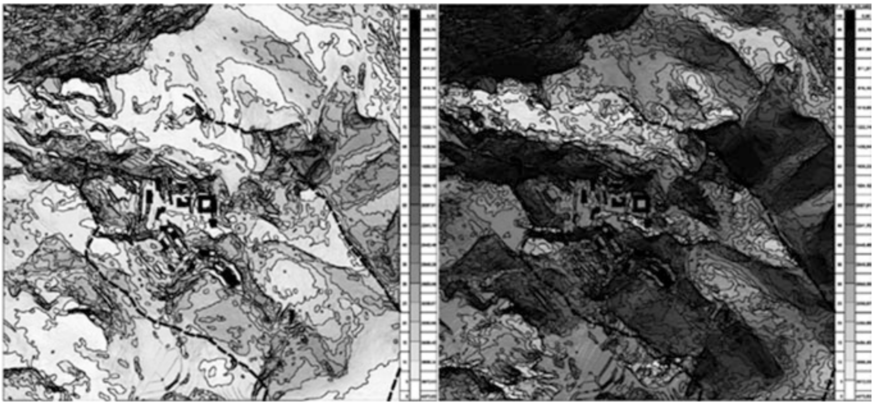

Fig. 5 Irradiation maps corresponding to the summer and winter seasons. Scal1: 5000 scale

Fig. 6 Section of the Fontilles valley with the buildings on the east slope

while buildings in the later stages of growth, were somewhat remote from the nucleus. The other element that allows us to understand the mechanisms for occupying the valley and its process of anthropisation are the system of terraces that were used for farming and the irrigation channels for watering them. In this way, the land implementation strategies at the Fontilles Sanatorium stemmed from a combination of concepts based on hygiene and landscape issues, giving it an extremely unique heritage asset status.

5 Landscape Units, Visual Impact and Perception of the Complex

The visual perception of the complex comprising the natural scenery and the buildings that are part of the Fontilles Sanatorium has a unitary nature in how it is perceived, forming a so called *Landscape Unit* (Quijano de Rincón et al. 2013) given its particular autonomy from its immediate surroundings.

From the perception perspective of the complex, the relief of the land means that perception from the outside is kept to a minimum. Nevertheless, the complex, especially the older buildings, enjoy great views to wards the sea. The line of the valley where the sanatorium is built is such that you can not get a unitary perspective of it until you are actually within the complex. The views from the interior allow one to see the valley walls, with the boundary wall encroaching upon the visual field.

In order to determine these visual relationships, we relied on a viewshed study using gvSIG_Desktop software on the Digital Elevation Model provided by the Valencia Cartographic Institute. Viewsheds can be determined by locating on the Digital Elevation Model the specific point from which you wish to check the visibility. The software used outputs a raster file where each pixel that represents a portion of the land has a value of 0, if it is not visible, and a value of 1 if it is visible. To analyse the visibility of the complex formed by the valley, a path was defined starting at the entrance to the premises, and ends just in front of the Padre Ferris Hospital. The visibility of the itinerary was analyzed based on 25 points, integrating all the raster images into a single file. The shade of grey of the archive indicates the frequency with which the specific pixel is seen, where the values closest to white indicate a greater frequency of visibility. Lastly, the resulting image has been superimposed on a 1:5000 scale map supplied by the Spanish National Geographic Institute (Fig. 7).

To the images acquired through this process, contextualized to a regional scale (1:50,000 scale) and on a municipal scale (1:5000), one can appreciate the two mechanisms used to configure the perception of the complex and define its visual impact.

In the regionally scaled image, it can be seen that the interior of the valley is represented by a north-east facing opening providing wide views. The territory perceived from within the valley extends across the flood plain, stretching as far as Denia and the foothills of the Montgó nature reserve. Nevertheless, there are no points in close proximity to the complex from where the interior of the valley can be observed. This implies that the inside of the complex has views of the outside, while on the contrary, the vision from the interior of the valley is made difficult by the distance of the points from where the valley is observable.

Fig. 7 Viewsheds towards the exterior o the Fontilles Valley. 1:50,000 scale. Viewsheds from the interior of the Fontilles Valley. 1:5000 scale

In the municipal scaled image, it can be seen that the landscape unit defined by the Fontilles Valley presents with a high degree of autonomy, given that the areas marked as visible are continuous, the upper limit of which coincides with the position of the boundary wall. Within the walled compound, two distinct, invisible areas can be seen which are visually disconnected from the landscape unit: the southern limit of the complex, which is south-facing, and the bottom of the gully, which, given the slope of the hillsides, can not be observed. As such, the interior of the complex is practically invisible from its immediate surroundings. The only views of the interior of the valley are from points in the far distance, as appears on the regional scale visibility plan.

The fact that the valley has a practically enclosed landscape unit, with views towards the outside, but difficult to observe caters to the needs of a hospital complex where the patient care programme requires isolation from the surrounding area, while being able to see the sea and benefit from the sea breezes.

6 Diachronic Study of the Evolution of the Fontilles Landscape

The abundance of photographic documentation of the Fontilles Sanatorium, allows us to appreciate how much the architectural complex and the landscape have evolved, practically from the day of its founding through to the present day. In order to show the transformations that both the buildings and the landscape have undergone, a diachronic analysis was carried out based on a comparison of old photographs and photographs showing the present state (Figs. 8 and 9).

So that the comparison between the historical images and the current conditions are accurate and intelligible, an analysis of the antique photographs will be carried out to precisely reconstitute the viewpoint from which they were taken, so that comparable photos of the present day can be taken from the same position and in the same direction. A graphical procedure will be used to analyse the photographs

Fig. 8 Different perceptive strategies. Views towards the outside (opening) and towards the inside (privacy)

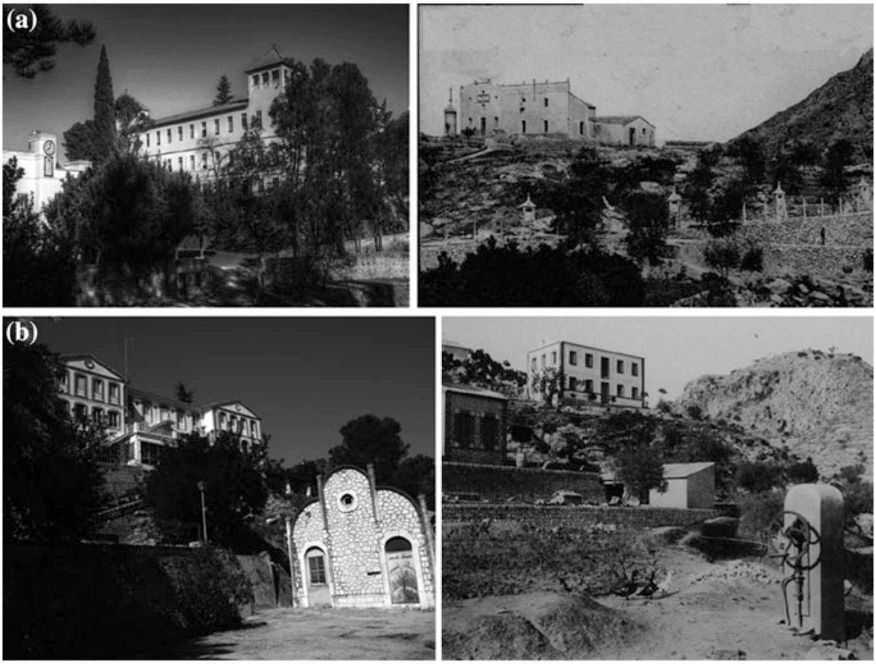

Fig. 9 Image **a** two concurrent views of the Padre Ferris Hospital. Image **b** Two concurrent views of the guest house

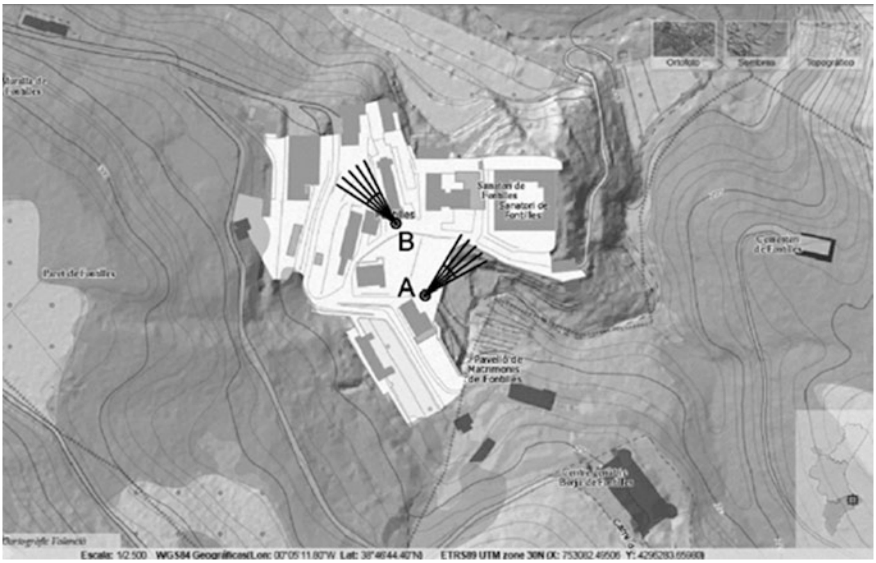

Fig. 10 Master plan indicating the position from where the images *A* and *B* were taken

by applying the geometric fundamentals of perspective. As a first stage, the photographs were digitized eliminating any radial distortions so that the images could be assimilated through a conical projection. To restore the main elements of the projection, we can use some of the known geometric relations of the scene, such as the perpendicularity between edges, and the angle that these form. Furthermore, determining the horizon, based on the vanishing points of some of the horizontal edges, tell us the height of the camera.

Current photographic techniques and virtual reality allow us to create totally immersive panoramic images into which the historic photographic images can be integrated, as layers, to show viewers how the buildings and the landscape of the complex have evolved over the years. This can all be achieved by taking spherical panoramic photographs from the restored view points, that can be viewed interactively from any computer connected to the Internet, or using individual virtual reality goggles that provide an even more immersive visual experience (Fig. 10).

7 Conclusions

The original landscape implementation project at the Fontilles Sanatorium, and its subsequent evolution during the 20th century constitutes an extremely singular heritage asset. This rich heritage has been proposed to form part of the *International Coalition of Historic Sites of Exclusion and Resistance* project, comprising eighteen former leper colonies, both in Europe and in the rest of the world, with the aim of having these sites declared UNESCO World Heritage Sites.

An exhaustive cartographic survey, of both the interior spaces of the complex, and the interior of the existing buildings highlight its heritage value. With the regionally scaled graphic analysis of the complex, we are able to characterize the landscape by identifying and describing the Landscape Units that go to make up the Sanatorium. The analysis of the viewsheds that display the relationship between the inside and outside of the complex show its unique nature with respect to its immediate surroundings. All this graphic information is used prior to the formulation of a Landscape Programme which will contain the set of preservation measures and activities and improvements, highlighting the landscape in order to achieve the landscape quality objectives formulated in the project.

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Photo-Collage e Rhetoric of Regime. Piero Bottoni and the Design of the Piazza of the Armed Forces at the EUR in Rome

Fabio Colonnese

Abstract In the twenties of last century, the contamination of the architectural drawing with photography and compositional techniques based on collage and inspired by figurative experiences of the European avantgarde, offers some authors the opportunity not only to amplify the visual realism of their renderings but also to convey a critical idea of the design space as well as of contemporary society through the contrast between drawn signs and photographic accessories. In the 1937 contest for the Armed Forces Plaza in Rome, Piero Bottoni demonstrates all the spatial and visual potentials of collage and montage techniques as critical means.

Keywords Piero Bottoni · E42 competitions · Photo-collage · Architecture photomontage

1 Photomontage in Fascist Italy

The first attempts to use photos as part of the architectural representation date from the early twentieth century by Friedrich von Thiersch and others (Nerdinger 1986) but from the 1920s on the urban scene starts to appear in collages and photomontages by Dadaists and other artists of the figurative avantgarde like Paul Citroen, Podsadecki, El Lissitsky, and André Verlon (Taylor 2004, 189). Mies van de Rohe soon learned to use photomontage first for realistic visual simulations, then to produce impressive images of his glass skyscrapers to promote himself as an artist-architect more than presenting the regular work to his customers (Lepick 2001). In 1924 Theo Van Doesburg and Cornelis van Eesteren made a perspective view of their project for a commercial building in The Hague which exemplifies the effect of the interaction between architecture design and photography. The contrast between the buildings drawn in the background and colored according to Mondrian's palette and the photographic black-and-white figure cut out of a

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newspaper, is very strong and represents a clear break with the canons of architectural representation of academic and pictorial tradition (Colonnese 2012). Moreover the figure does not depict just an ordinary person to conventionally suggest the size of the building, but the Greek sovereign Constantine, who was then in exile in Sicily. This choice opens the doors for new intertwined meanings, not least to an open reflection on the meaning of the spatial representation and its many levels of reading.

In Italy architectural photomontage is especially vital in the artistic and political Milan, thanks to authors such as Pietro Maria Bardi, author of the photographic "Table of Horrors" at the Second Exhibition of Rational Architecture in 1931, Giuseppe Pagano and Giuseppe Terragni, author of photomurals for the Exhibition of the Fascist Revolution in 1932. Many of these experiences were rooted in previous Futuristic experiments (Lista 1981) as testified by authors such as Luigi Veronesi, Bruno Munari, who since 1933 produced the famous photomontages *Atmosphere 1933* for the Bompiani Almanac (Silk 1996) and Marcello Nizzoli, working with Terragni and processing installations and photographic montages for his Casa del Fascio at Como (1932–36).

In the same years the camera gradually turned from an objective investigation tool into an expressive instrument, able to enhance not only the works but also their authors. Collaborations between architects and photographers were stablished while some architects became photographers themselves, introducing photographs in their project presentations and often experimenting with collages and photomontages, like Carlo Mollino. Their spread in architecture and exhibitions is indirectly evidenced by the critical words of Marcello Piacentini, an influential member of the board of the institution of the Milan Triennale, who condemned "the system of photomontage widely used in V Triennale […] proposing a greater attention to the development of models […] with a prevalence of graphic materials than the photographic ones" (Savorra 2005, 120).

2 Piero Bottoni's Photomontages

In the thirties the Milan architect Piero Bottoni (1903–1973) is participating with great enthusiasm in the process of urban and cultural regeneration impressed by the Fascism. His vast production not only touches all architectural scales but reveals an unusual curiosity for both the traditional arts and new media, such as photography and cinema. He produces short films, like *Una giornata nella casa popolare* (1933); processes proposals for the creation of a fantastic setting in the movie "through the reversal from positive to negative of either the only background or the only character in the foreground" (Consonni et al. 1990, 55); prepares photomontages in the Sala introduttiva of the Sezione Internazionale di Urbanistica at the Triennale.

The first photographical traces in his architectural drawings date back to the project for a building in Piazza Fiume in Milan (1934, with Prearo), in which a wireframe perspective view is inserted into a picture of the square. This kind of photo-mounting or insertion of a design drawing within a photograph of the context bases on the principle of the perspective restitution to match the setting of former with that of the latter. Photomontages had already been required in International architectural competitions (Lepick 2001, 324) but in the Italian context this is to be considered as an innovative communication format.

Among the photographic accessories Bottoni applies on the perspective views for the Via Roma district in Bologna (1936–37) there are female figures, a tram and a car passing on the road perpendicular. They not only add verisimilitude to the graphite renderings but also evoke elements from the metaphysical squares painted by De Chirico, already explored at the time of his *Morte meccanica: le masse* (1928). An aspiration to pictorial models is evident in the competition project for Piazza del Duomo in Milan (1937, with Giordani and Pucci). The view of Piazza Giovinezza/Mercanti, the most isolated and intimate site of the project, is conceived as a montage in a photograph of the existing building with the inclusion of the design elevation in the bottom and a plastic group of four gentlemen in the foreground, among whom the architect himself can be recognized.

Bottoni's architectural production intertwines also with the suggestions coming from Le Corbusier, with whom he had corresponded in 1927 about his *Cromatismi Architettonici* (Colonnese 2016) and whose urban proposal he was studying for the sixth Triennale. Until 1935 Bottoni's perspective views used to show academic cross-hatching in pencil and colored crayons exalting chiaroscuro and textures, often enriched by accurate picture of the vegetation and human figures often engaged in actions that illustrate narratively the architectural design. The three-dimensional view of the proposed extension of the villa Cicogna in Bergamo (1935) seems quite a tribute to the Swiss architect, not only in the formal repertoire, precociously assimilated by Bottoni and other architects from Milan and Como, but also in representation of buildings and environmental elements. In the drawings of the Salonit pavilion at the Belgrade Fair of the same year the trees are reduced to wavy lines apart, simply sketched like so many Le Corbusier's drawings. In this project Bottoni investigates the "photo-collage" that is the application of photographic fragments onto a traditional inked drawings. Not only human figures but also a car, flags and billboards are cut and pasted from photographs. Such a photographic mapping extends also to the tubular elements designed for the exhibition apparatus and the treatment of the materials expected on the curved surface of the high pavilion input and the path back, which inevitably show some inconsistency with the perspective structure of the building (Fig. 1).

Also the presentation graphics for the competition project '5 C.M.' for the new Trade Fair in Milan (1937–38, with Lingeri, Mucci, Pucci and Terragni) generally refer to Le Corbusier's drawings, but there is more. The ground is marked by a perspective grid that seems to evoke the rarefied squares painted in the Renaissance ideals city, such as his "beloved" Sforzinda by Filarete, calls the photomontages that Mies van de Rohe was experimenting in the same years and even foreshadows Superstudio's postwar works. The wide views of the stretched space of the entrance, barely constrained by flag poles and Le Corbusier style trees, show an unusual compresence of drawn and photographic elements: people walking down

Fig. 1 Bottoni, Lingeri, Mucchi, Pucci e Terragni. Competition project for the new Trade Fair in Milan, 1937–38. Perspective view of the hotel and restaurant. Op. 167, 12. Archivio Piero Bottoni, DAStU, Politecnico di Milano

the sidewalks are drawn while those in the foreground are cut out of newspapers as almost all cars. These photographic fragments not only constitute a counterpoint to the transparency and scarcity of buildings made of frames and plans but offer a theatrical and pictorial quality to the views, especially the promenade of photographic human figures pasted on the perspective of the restaurant for 10,000 people.

This stage of Bottoni's architectural production shows both photomontages simulating the presence of the design in the context, and photo-collages designed to enhance the realism of the rendering or to suggest pictorial and critical values, emphasizing the contrast between elements drawn and photographed, as in the case of the project for the E42, the original Expo in Rome, then converted in the district called EUR.

3 A Piazza for the E42

In the atmosphere of monumental interventions that affects the Italian capital (Cimbolli Spagnesi 2007), in the summer of 1937 the agency for 1942 Universal Exhibition of Rome calls a "Competition for the design of the Armed Forces buildings". The site is the curvilinear south end of one of the three original *decumani* which today can be approximately identified with Viale Europa with the church of Saints Peter and Paul at its north end. The buildings are expected to house the museum of the three Forces: Army, with the history of the wars from the Roman age; Aviation with the halls of precursors and technology; Navy, with the history of navigation and ancient ships.

The solution proposed by Bottoni, Mucchi, and Pucci gets a mention, but it is not admitted to the second grade of the competition. The winners De Renzi and Figini & Pollini are instead requested to draw up a plan together for a building that is no longer destined to the Armed Forces but to E42 Corporations building, which will be then converted into the State Central Archives.

The sixteen panels by Bottoni's team illustrate an anti-classical composition obtained through overlapping rectangles and juxtaposition of parallelepipeds that seem to flow on a tall basement to delimit a large cross square, ignoring the curved shape of the site (Fig. 2).

The sketches preserved in the Archivio Piero Bottoni in Milan testify to the gradual abandonment of symmetrical solutions in favor of an asymmetrical arrangement of the volumes around a cubic transparent shrine according to the Neoplastic grammar. Beyond his belief about the superiority of linear bodies (Bottoni 1936), Bottoni's vocabulary finds its figurative (or rather anti-figurative) references in some abstract experiments by the previous decade vanguards. One could easily cite Lizzisky's *Proun*, Malevich's *Planiti*, Van Doesburg's "basic shapes" and "compositions" as well as the single family houses by Mies van de Rohe. In the catalog for the 1936 exhibition *Cubism and Abstract Art* at the MoMA in New York, Alfred H. Barr, Jr. had associated Mies van de Rohe's plan for a country brick house to Van Doesburg's *Rhythm of a Russian Dance* (1918), setting the ancestry of Mies's artistic architecture from the De Stijl movement (Martins 2001, 124). Terragni also was testing compositions of either combined rectangles—in the front of his lakeside villa (1932)—or overlapped rectangles—in the plan of Villa Bianca (1936–37). The most striking similarities with Bottoni's project can be

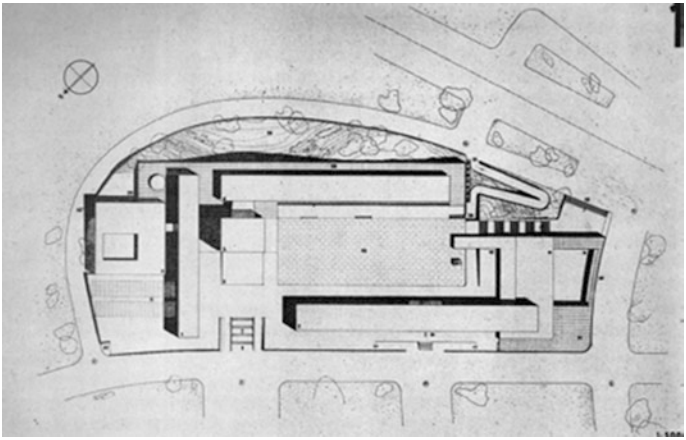

Fig. 2 Bottoni, Mucchi, Pucci. Design for the Armed Forces piazza at E42. Op. 166. General plan. Archivio Piero Bottoni, DAStU, Politecnico di Milano

found in the works of the artist Mario Radice, particularly the large plastic wall (Fig. 3) for the Sala del Direttorio he built in the Casa del Fascio in Como between 1936 and 1938 (Casero 2010) on the basis of his previous frame work composition CF 123 B (1934). Given the friendship and collaboration between Terragni and Bottoni—in September 1937 they were completing drawings for the Fair of Milan—it is plausible the project for E42 was directly influenced by the works by Radice and Terragni.

It is interesting that Bottoni adopts a vocabulary of elementary forms in response to a monumental program theoretically oriented to rhetoric of the regime. Even more surprising is his ability to maintain such an abstraction in the elevations, giving up more or less revised versions of the architectural orders and limiting the contribution of statuary. In fact, compared with other competitions entries in which the sculptures abound, Bottoni's project lacks of figurative works with only a relief suspended in the cubic case and an equestrian statue, whose task seems to close virtually the fourth side of the square, to suggest the human scale and to evoke the metaphysical world of De Chir ico's landscapes. The true protagonist of the project is the empty space—the square—delimited by elementary architectural bodies.

The square is not the residue of a court to which gravitate the buildings and the people who inhabit them but a space freed from functions and therefore monument and art, as in the rigid conception of Adolf Loos. This is confirmed by the choice to orient the generous windows of the buildings to the outside, keeping inward only narrow slits that enhance the marble cladding. "The result is an image of a metaphysical place where the solitary body of the building of the Royal Army can stand up to show, behind veiled transparencies, the main hall with the large stone bas-relief" (Consonni Meneghetti and Tonon 1990, 95).

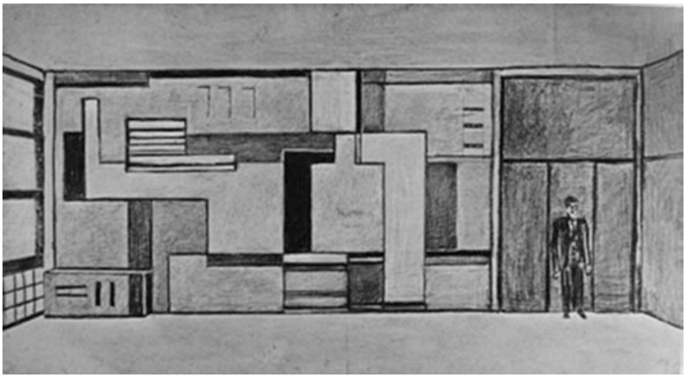

Fig. 3 Mario Radice. Design for a wall decoration in the Sala del Direttorio at the Casa del Fascio in Como, 1936–38

4 The Image of the Square

Despite the attention given to internal solutions of the three museum buildings that would deserve a separate discussion, the square is the central theme of Bottoni's architectural proposal for the E42 and the abstraction implied in its design also influences the design communication. The monochromatic model suggests a sculptural reading of the project, both for its monolithic aspect and for the absence of scale reference. The abstraction perceived through the model's photographs also invests the three perspectives onto the second and third panel expressly required by the call, thanks to the grids of the smooth marble cladding and the few shadows.

The competition program requested candidates to present views from "real points of view" and Bottoni makes several attempts as testified by photographs and sketches by both freehand and geometrically constructed. But in the end he presented the view along the monumental axis from an high viewpoint (Fig. 4). The field of view is expanded beyond 120°, to reveal the piazza on the right and put the complex in connection with the distant landscape. The arrangement of the volumes seem to replicate the visual model built by Canaletto in some panoramic views of Piazza San Marco, with the cubic Sala d'Onore instead of the bell tower to act as a pivot between the arcaded square and lagoon in the background (Fig. 5).

The choice of high viewpoint is useful to show the general layout and the articulation of the ground level, but involves two problems: the difficulty of finding suitable photographic complements and the risk of losing the apparent monumentality of the complex. Therefore Bottoni dwarfs the human figures the way Giovanbattista Piranesi did to increase the apparent scale of architecture in his engravings.

The other perspective view of the piazza (Fig. 6) suggests more links to the ideal Renaissance city. The design of its boundaries seems conceived to parasitize the

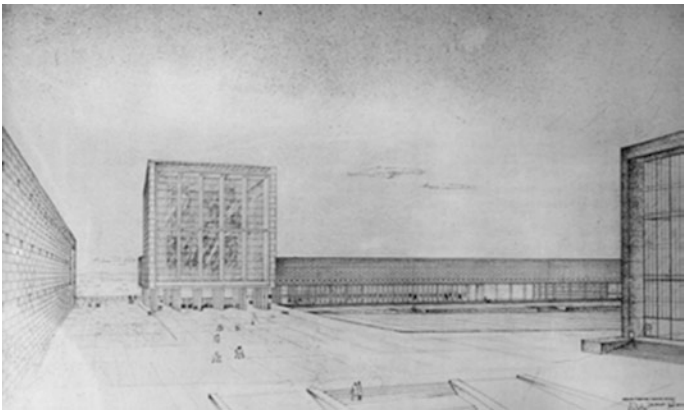

Fig. 4 Bottoni, Mucchi, Pucci. Design for the Armed Forces piazza at E42. Perspective along the monumental axis. Op. 166, 28. Archivio Piero Bottoni, DAStU, Politecnico di Milano

Fig. 5 Antonio Canal, known as Canaletto, View of Piazza San Marco, 1752. Wadsworth Atheneum, Hartford, CN

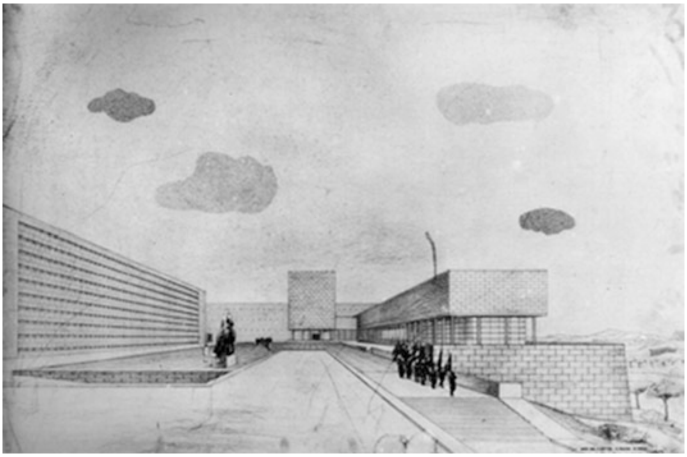

Fig. 6 Bottoni, Mucchi, Pucci. Design for the Armed Forces piazza at E42. Perspective of the square. Op. 166, 29. Archivio Piero Bottoni, DAStU, Politecnico di Milano

observer's habit to symmetrical compositions. As in the Renaissance artists' practice to present two alternative design solutions with respect to the axis of the building (Carpiceci and Colonnese 2012), Bottoni leaves his readers the task to mirror each half to recompose a symmetrical square (Fig. 7). If one considers also the alienating effect of the small parade of men in uniform cut from a photograph, then cannot but agree with Consonni's words: "the atmosphere the drawings evoke is that of a place outside of history" (Consonni Meneghetti and Tonon 1990, 95).

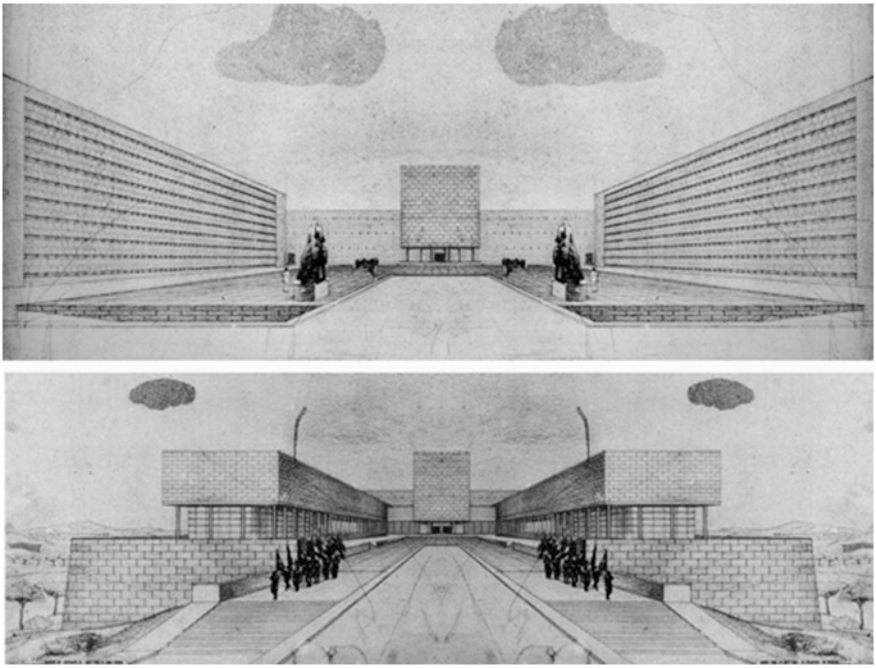

Fig. 7 Symmetrical montages of the Armed Forces square (elaboration by F. Colonnese)

5 Collage, Montage, Representation

As evidenced by these readings, the project by Bottoni, Mucchi e Pucci is extremely complex and lends itself to many interpretations. Critics have already highlighted that most of Bottoni's architectural production has been forming around the oscillation between the two poles of painting and sculpture, which "act as a medium of his figurative and spatial sensitivity and imagination" (Consonni et al. 1990, 51). The tension between sculpture and painting perceived in the perspective views is also present in other aspects of the project and is fundamentally generated by the choice of responding to the symbolic and urban program in a rhetorical and monumental key with a piazza made of abstract volumes alluding to pictorial historical models.

Consider, for example, the circulation. Coming along the *decumano* the observers only capture the shrine above the base, located along the monumental axis, as the call requested. Approaching the base of the little Acropolis the two orthogonal linear bodies of Air Force and Navy buildings proclaim the fundamental sizes of the complex. Stepping up the main staircase the gaze is seized by the transparent cell in the backlight. Just before reaching the upper floor the piazza appears on the right

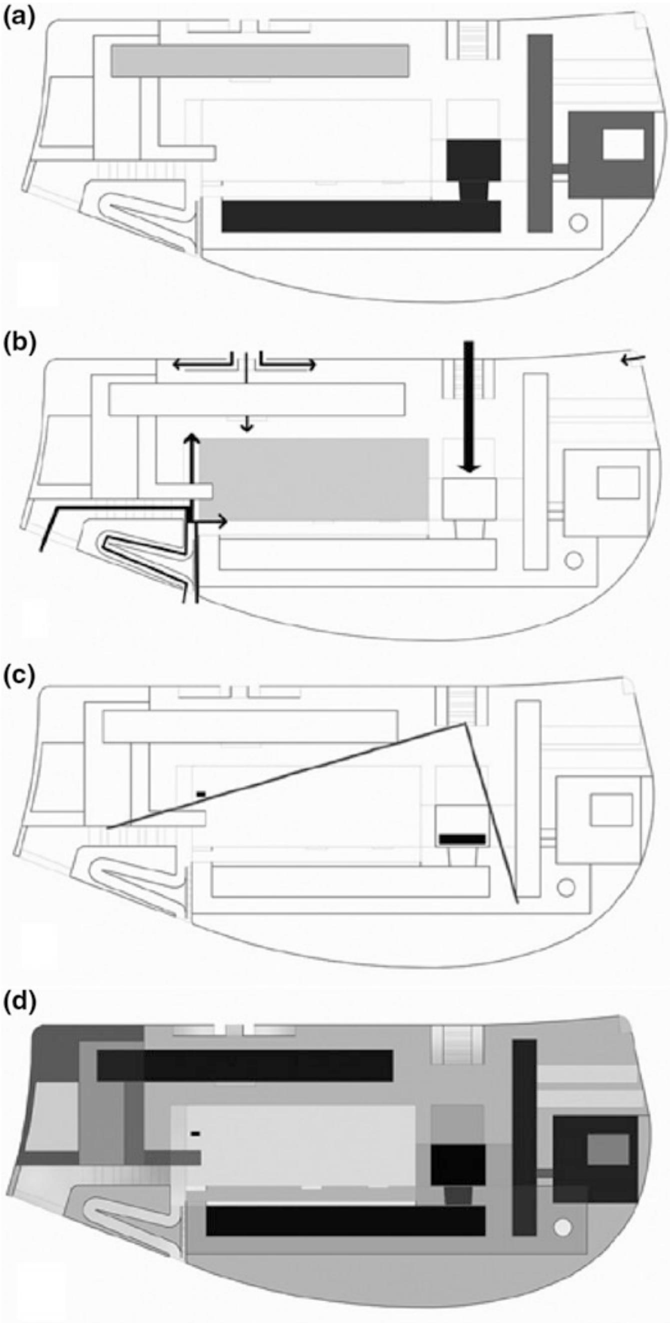

Fig. 8 Analysis of the general plan: **a** Buildings of Army (*black*), Navy (*gray*) and Aviation (*light gray*); **b** Routes to the square lowered; **c** Cone main visual (90°) and works of art; **d** Collage (elaboration by F. Colonnese)

and calls for a rotation of the gaze up to frame the equestrian statue in the background of distant hills. The processional route is ambiguously contradicted by not only the transversal lowered piazza but the interweaving of secondary pedestrian and vehicular routes (Fig. 8) that guarantee continuous surprises and encourage bodily exploration. The volume configuration prevents the eye to get lost on the horizon behind it but reflections of the distant landscape penetrate the tetrastyle pilotis portico holding up the backdrop and illuminate the foreshortening Navy building. A new ramp *d'onore* leading to the entrance of the Hall redirect the gaze up toward the "wide partly transparent, partly color stained glass through which one can see a large sculptural composition designed in a unique artistic conception with the figures of the glass and fused with them" (Bottoni et al. 1938).

The attention to a progressive unveiling of destinations and routes might be influenced by Le Corbusier's *promenade architecturale*, which implies the idea of montage that the Swiss architect had inherited from Choisy and perfected thanks to film and writings by Eisenstein (Bois and Glenny 1989). Instead, both for the design of architectural volumes and the criteria of representation Bottoni seems indebted to Mies van de Rohe. Since 1929 German pavilion, Mies had begun to combine industrial metal structures, slabs of marble and ornamental sculptures, pushing his architecture towards a form of open work that required the observer an active and kinematic perception of space. Parallel he was developing a kind of photo-collage with photographic snippets of materials, furniture, works and landscapes glued onto pencil or pen drawings that he considered useful to illustrate his idea of architecture as a juxtaposition of planes, *objets trouvée* and landscape. In this research Mies was chasing an original synthesis of the elementary figures theorized by De Stijl and the *objets trouvée* beloved by Dada. "Where the Expressionists had theorized pure artistic means– pure color, line and plane—as preconditions for art, the Dadaists accepted found objects as their raw materials" (Martins 2001, 113) and did not pursue a synthesis between the forces, some new formal unity but a fragmented environment, analytical, the perception of which required a continuous and "active negotiation between subject and object, organism and environment" (Martins 2001, 112) (Fig. 9).

6 Conclusions

The most interesting aspect of Bottoni, Mucchi, and Pucci's proposal for the E42 is that the critical quality toward the urban, political and even programmatic context finds expression through a common key, which is that of collage and montage. The architecture rises from a plan that is an abstract painting, a sort of *papier collée* composed of geometric and figurative pieces that evoke a latent units, more mental than physical. Both the piazza and the buildings that enclose it are far from the

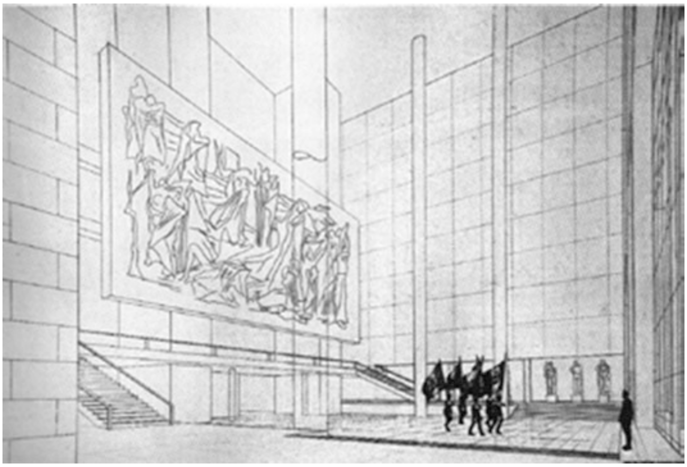

Fig. 9 Bottoni, Mucchi, Pucci. Design for the Armed Forces piazza at E42. View of the Sala d'Onore. Op. 166, 35. Archivio Piero Bottoni, DAStU, Politecnico di Milano

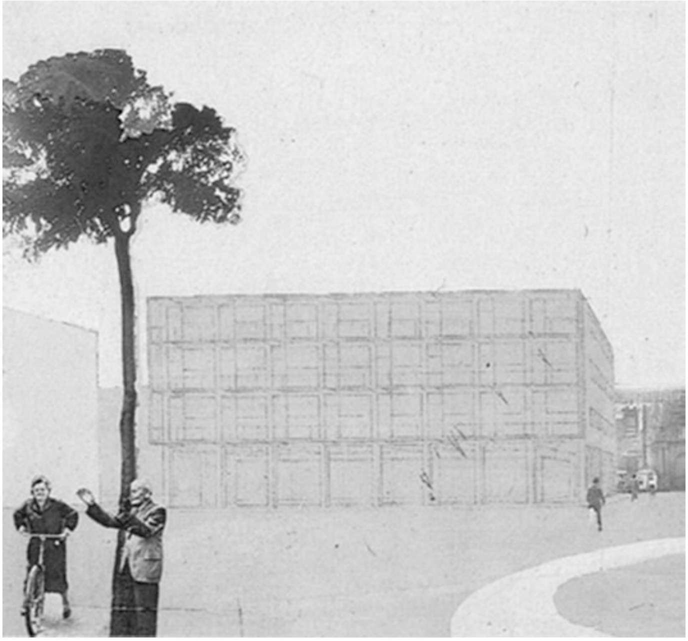

Fig. 10 Bottoni. Project of Piazza Fontana, 1952–55. Perspectival collage (part.). Op. 333, 45. Archivio Piero Bottoni, DAStU, Politecnico di Milano

classicist and rhetoric expectations of the regime. They rather offer a place to relax the senses, a platform to renegotiate the relationship with the horizon and discover the distant landscape, through the windows of the exhibition galleries.

Even the collage representations appear declined critically, in tactile rather than optical way. There is no photographically multiplied crowd cheering the leader as can be find in other more "obsequious" projects but a few figures in uniform marching with photos that do not seem to share time and space staged by architecture. As mentioned about the view by his friend Cornelis Van Esteren, their mechanical poses appear "out of place" as *objet trouvée* which are out of tune of the atopic square harboring them. It is important to mention that those collages were arranged by a man who had welcome the seeds of the earlier Fascism reforms but had a sincere communist inclination. These signs inevitably record "the suffering of those who possess an ideal tension of social transformation that the course of events proves to have been misplaced (a little later the sanctions against the Jews that directly affect Bottoni's family in the person of his mother bring a further confirmation)" (Consonni et al. 1990, 95). It is no accident that already in 1941, on the occasion of the publication of the project on *Casabella* 158 dedicated to "lost opportunities" of Italian architecture, under the plan appears the perspective view of the piazza, properly purged of the figures in uniform.

The war years'designs by Piero Bottoni remain often uninhabited. Human figures nearly disappear from his perspective views as if he had lost his confidence in human kind. Sometimes figures are reduced to painted stains or ethereal doodles, similar to the ghosts "that exist and not exist at the same time" (Espuelas 2004, 64) which Mies van de Rohe drafted on the views of buildings of MIT in 1944. They resurface only years after the end of the conflict, like the photographic figures of elderly people placed in the foreground of the photo-montage of Piazza Fontana in Milan (1952–55) or the statues of his war memorials, particularly the famous partisans ossuary at the Certosa of Bologna (1954–59), as a sign of a painful reconciliation with human kind (Fig. 10).

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Graphic Study of Surfaces of Movement in the Proposals of Andrés and Alonso de Vandelvira. Formal and Constructive Views of the *bóveda de Murcia* and the *ochavo de La Guardia*

Antonio Estepa Rubio and Jesús Estepa Rubio

Abstract We work into the study of some geometric formulations, designed or built by Vandelvira, whose results prove that the projective conciliation and the executive design in the peninsula along the sixteenth century was the fundamental basis on which was conceived the production that today we inherit. The complex thinking and knowledge of trades allowed that the expressive proposition of that kind of architecture could fly to unimaginable heights in previous periods. We present evidences that exemplify how the seal of Vandelvira had a significant weight to get this, and why it had naturally been recorded among the best pages of history.

Keywords Vandelvira · Stereotomy · Andalusian renaissance

1 Introduction

The work of Andres de Vandelvira, together with the manuscript of his son Alonso, is an ideal framework for research if, as the case for this exercise, we work with protocols and graphical tools to understand the compositional and executive intentions underlying in their interior, although sometimes are unnoticed in spite of the existence of the best art-historical contributions of our geographical location.

Specifically we will study a couple of design solutions that are installed in the modern logic to respond of demands through the fewest number of divergent situations. It comes to show us the genius and effectiveness, technical and of design, of this master.

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The analysis of the abstract concepts of Vandelvira, through a comprehensive study on descriptions worked by Alonso de Vandelvira for cases of the *bóveda de Murcia* and *ochavo de La Guardia* allow us to understand their capacity for innovation, and their mark for the constitution of a new design ideology.

Concretely, according to the nature of the case studies, we propose a reflection on the use strategy of the surfaces of movement to solve, with the same executive proposal, formal or compositional options and structural or constructive situations.

The graphic methodology reflected in the treaty of his son is a precious relic which helps us to understand how really was the process with which he worked Vandelvira, and it shows us that there were overlaps in the use of different solutions, that in fact allowed him to think about new formulas, or perhaps obout other ones insufficiently explored.

2 Assessment of the Formal and Executive Model Described By Alonso de Vandelvira for the *bóveda de Murcia* and for the Rest of His Case Studies

In the manuscript of Alonso de Vandelvira we find a model named as *bóveda de Murcia*, which also expands to a more developed model referred as *bóveda de Murcia por cruceros*, and which is related to the solution of Quijano to the *Capilla de Junterón* in Murcia; although with a less formal exaltation derived of the Vandelvira's limit through a vertical plane, in addition to the horizontal plane of Jerónimo Quijano.

In this sense the graphic description of Alonso de Vandelvira seems to be crystallized over the Quijano's solution for the dome of the Murcia's chapel, where the path of the circle shows the rotation about an axis parallel to the ground plane, because unlike what it happens in the execution of La Guardia, we can see here a horizontal geometric solution, and that into the *ochavo* is lost, mainly due to the intrusion of a vertical plane which is the limit to the shape of the model.

The uniqueness of this geometry emerges from the plant, since its section arises from a much simpler structure, because its logic is based on a network of concentric circles, or what is the same, there would be more complicated than the explained solution by Vandelvira for hemispherical domes.

The toric surfaces are symmetrical about any plane containing its axis of revolution, allowing us to reduce the complexity of executive problem, if we previously try to cut the surface in a logical and orderly manner, like Vandelvira does, making slices of subdivision always of equals measures. Applying this idea to the torus we can reduce it to the multiplication of a constant concatenated segment, that for this particular case (drawn by Alonso de Vandelvira) is obtained by dividing a straight angle in seven equal parts, the result of which would born by the work of only a slice (Fig. 1).

The Vandelvira's operation to explain the formula of the *bóveda de Murcia* is not coincident in its general approach and its singling in the case of the *bóveda de Murcia*

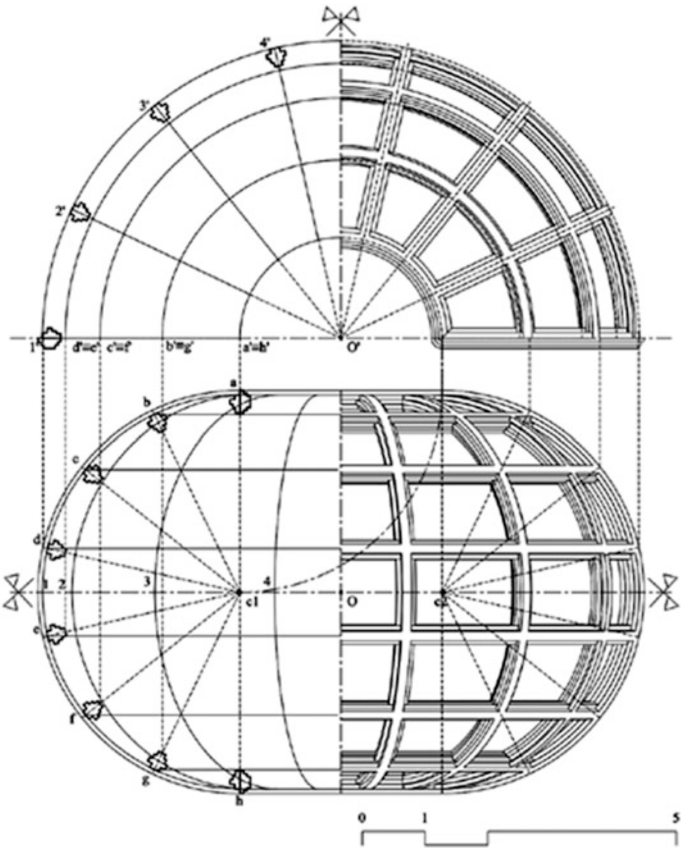

Fig. 1 Geometric development of the *bóveda de Murcia por cruceros*. Drawing by Antonio Estepa Rubio

por cruceros, for the first case he decides to solve developments on the ground, but in the second case we see that appears a complementary sectional drawing, equivalent to cutting appearing for the *capilla redonda por cruceros*, where we know that the fit of nerves is not arbitrary, but dependent on the correct way for a formal and visual proportion of the projected location for the coffers (Fig. 2).

It is also worth considering the differentiation between the formal axes of Vandelvira and the derivatives of the construction joints, because while the general case of the *bóveda de Murcia*, Vandelvira chooses alternating joints that stiffen the model, to the specific case of the *bóveda de Murcia por cruceros* the ideal choice would be to use runs along fixed power lines which logically are those wherein the structural stress is reduced, that is, in exactly in the half of the generatrices.

The closing of the surface for the general case would be automatic, but for the cruises solution requires a supplement to cover its outline; although the calculation of each of these pieces is reduced to half for the number required by slice, since

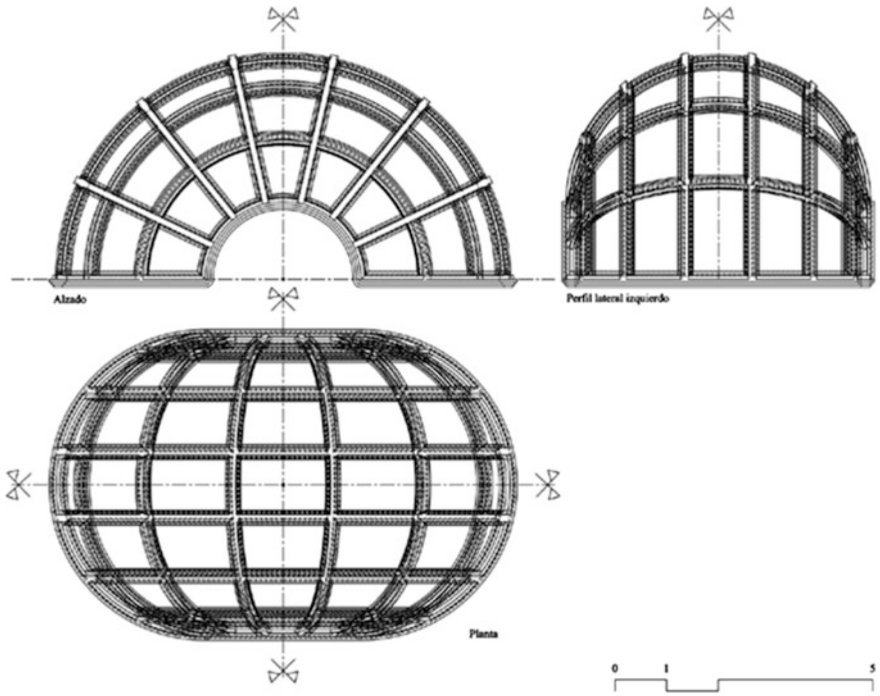

Fig. 2 Formal constitution of the bóveda de Murcia por cruceros. Drawing by Antonio Estepa Rubio

there is a symmetry plane passing perpendicularly through the axis of revolution and containing the center of the generating circle (Fig. 3).

This reflection can be interpreted in a useful way to answer about another series also worked by Alonso de Vandelvira in his treatise, as for example for plant oval chapels. In this line, the son of Vandelvira begins with a pair of matching models with Murcia cases, we refer to the *capilla oval primera* and the *capilla oval segunda*, where the formal constitution varies only in that instead of using an arc as generating curve is used fragment of an oval, while maintaining the generatrix still satisfy the revolution about a horizontal axis. The *capilla oval primera* come to be to the *bóveda de Murcia* and the *capilla oval segunda* to the *bóveda de Murcia por cruceros*.

Alonso de Vandelvira also dares to violate the imposition of a circular twist, it is proposed to overcome the surfaces engendered by revolution about an axis to investigate geometric formulas derived from the translation of a curve through a path. This is what happens for the cases of the *capilla oval tercera* and the *capilla oval cuarta*, where the transfer of an arc through the oval path described by the other half oval (contained in a vertical plane) is sought. The difference between the *capilla oval tercera* and the *capilla oval cuarta*, as happened to the first two types, is based on the presence of nerves, or as noted above, if formal logic is to be a continuous surface or a network of nerves with subsequent closure.

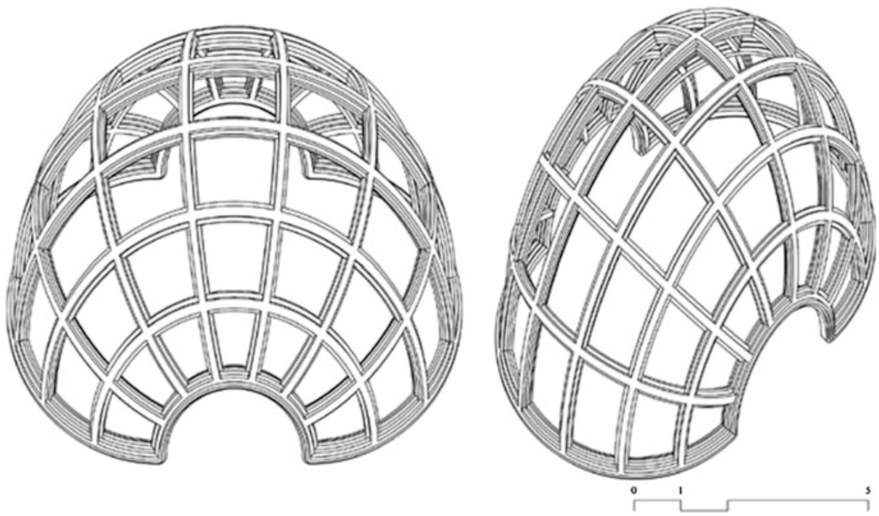

Fig. 3 Egyptian and military axonometrics of the *bóveda de Murcia por cruceros*. Drawing by Antonio Estepa Rubio

For the third and fourth cases, it would be considered an issue which is important since it involves an obvious geometric break over philosophy that the composite is used in the series of the *bóveda de Murcia*, the *bóveda de Murcia por cruceros*, the *capilla oval primera* and the *capilla oval segunda*; this is based on that the transverse cutting lines for all cases above are obtained by the intersection of the surface with a beam of planes that contain the axis of revolution, since the longitudinal cutting lines resulting from the intersection with a beam that is parallel to the vertical plane, or what is the same, while the transverse lines are equals to the generator flat surface, the longitudinal lines are perpendicular to the axis principal segments.

For the *capilla oval tercera* and the *capilla oval cuarta* the linear networks cutting curves change significantly, as formalized by a beam of planes parallel to the horizontal plane, and a beam of planes containing the minor axis of the oval. However this manipulation is not free, it is quite justified by Vandelvira in his explanation, while this decision allows him to take the decision to open an oculus on the side of greater height, without reducing the strength of the structure as it had already resolved for the *capilla redonda por cruceros*, which also shows its constructive solution.

Executive and formal assessment model of the singular head of the Parish Church of the Convent of Santo Domingo in La Guardia*, commonly known as* ochavo de La Guardia.

Not a few researchers believe that the *ochavo de La Guardia* is a concrete and specific case on the implementation of the solution worked on the manuscript for *bóveda de Murcia*; and indeed it is, as the same Alonso de Vandelvira refers to Murcia's case in explaining this model.

Accepted the convergence between the cases of Murcia and La Guardia, one might ask why this union, and further, the reason of why this solution has been listed in the same way, when in fact we can see that the general identity of the *ochavos* in the manuscript is dissolved, to become in a more generalized chapel constitution.

The answers seem to have the same explanation to study the link between the *ochavo de La Guardia* and the *capilla ochavada en vuelta redonda*. In both models we can understand an exceptional fact that is how download on the structural outline is not directly on top of the wall but through and why he works with arches of tensions that move the forces to the end, which allows a new reformulation that originally was impossible.

A *ochavo* is obtained from a plant derived from six sides of an octagon that is crossed by a vertical section through the center of the polygon; that is, this kinds of chapels usually come formalized by an open long side connected to the ship which serves (coinciding with the fictional plane of division), two sides perpendicular to the opening and whose length is a half of the side of the polygon, and finally, three sides with octagon unchanged values. On the other hand the *capilla ochavada en vuelta redonda* does not suffer any functional damage if we decide under his discharge fully or partially release the presence of the oblique walls, but yes, without altering the presence of the lateral arches; if we compare this directly with the intention of Vandelvira for La Guardia we can understand that chooses the elimination of the oblique walls to define a cleaner wall sleeve, and a rectangular contour that makes possible a much more flexible occupation of the plant (Fig. 4).

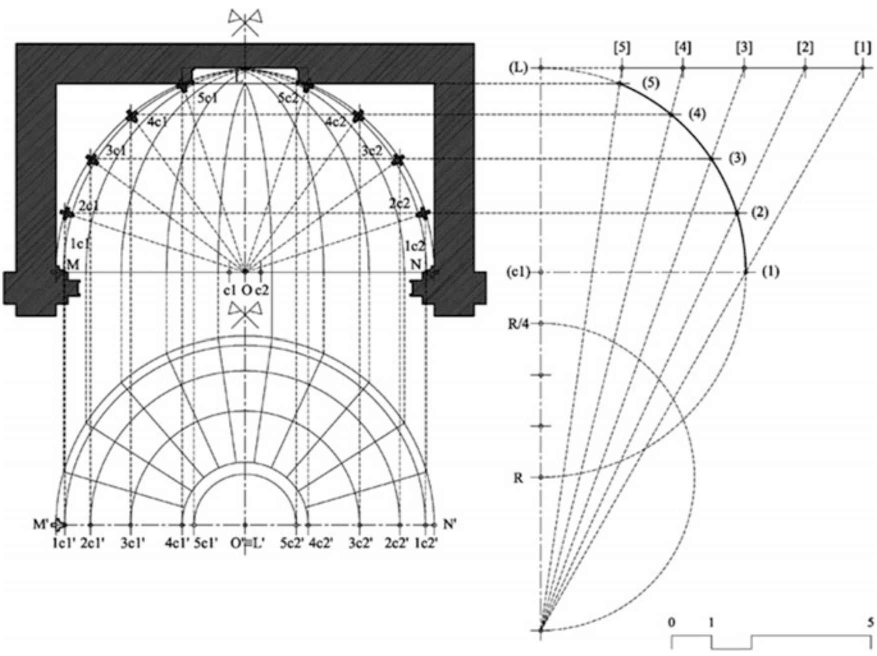

Fig. 4 Geometric development of the *ochavo de La Guardia*. Drawing by Antonio Estepa Rubio

According to the above comparison, Vandelvira dissolved the presence of the arc that allows the elimination of the oblique cloth using a smart strategy, which for more glory of the designer, is formalized at two different times; on one side to define a big belt like an *entablamento*, and secondly transforms the discharge arc in a figure that closes the space inwards, that is, instead of using a semicircle contained in a plane, makes use of a *trompa*, which would behave as a ruled surface like a cone fragment. This dual option allows Vandelvira to release the space inside the chapel and to make more floor space and raise more geometric transition, as well as allowing greater and better use of the plant, leading to outright targeting perspective.

The formula used by Andres de Vandelvira for the vault of the header in La Guardia is, as reflected in the manuscript, half of a *bóveda de Murcia* (similar to the *Capilla de Junterón*) which has been cut by a plane. It opens toward the ship, or in other words, perpendicular to the longitudinal axis of the building. Vandelvira choose a complex geometry, however, it is not recognizable to the naked eye, since it fails to recognize the path of a curve around another, like for example if it happens easily in Murcia.

Actually the solution of La Guardia, on which much has been written to be influenced by Quijano, could have been designed with the same result from a simple model, that is, from the use of a *capilla redonda por cruceros* rotated 90° to its axis of revolution to be parallel to the horizontal plane. Being strict about what Vandelvira intended, given the narrow dimensions that have to work, obviously it would have been much easier and less convoluted working with a quarter sphere, whose parts can be calculated by simple graphic movements, and from where It would be easy to get the templates of the processing (Fig. 5).

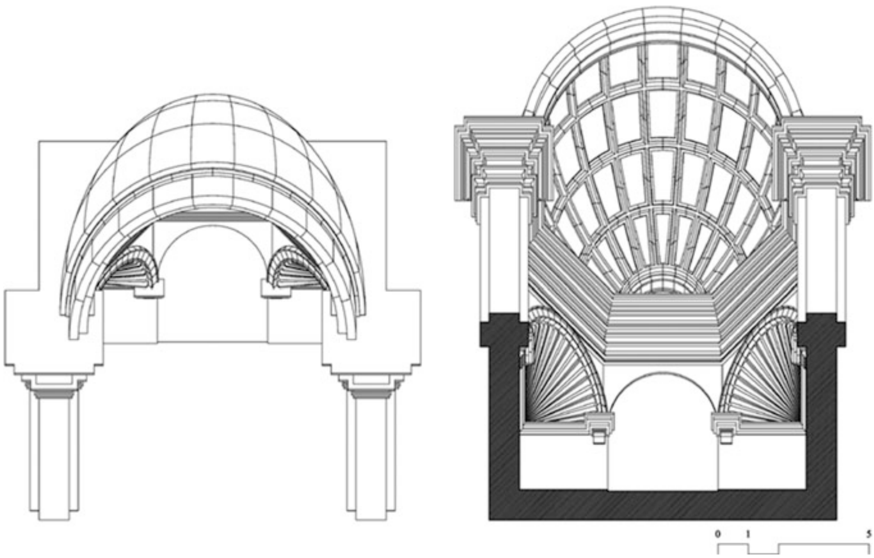

Fig. 5 Egyptian air and overhead axonometrics of the *ochavo de La Guardia*. Drawing by Antonio Estepa Rubio

If we draw with propositional logic the formula for La Guardia (according to the manuscript) and calculate the position of the centers of the horizontal arcs which must rotate around the axis of symmetry of the chapel, then it follows that the position of the centers are beyond to the axis of revolution, or what amounts to the same, the distance from the center of each generating curve to the axis has a negative value, which would imply the emergence of points conflicting and illogical, incomprehensible question to these surfaces; although to avoid this conflict Vandelvira proposes to unite the curve against of the back wall, behind which it wouldn't break the double curvature of the surface.

Once we have said the above, we might ask whether the solution which chooses the master based on a of a torus surface, for these dimensions and these conditions, it is correct and consistent with the final solution and the visual and atmospheric effect actually obtained, or conversely, if it had been chosen by a *capilla redonda por cruceros* turned 90º that would have been equivalent, while the process has been simplified; as, for example, he made similarly to decide that the trompas would be of the easiest possible way.

On the other hand, the constitution of the nerves on which rest the fillings were designed to be monolithic cruciform pieces that would allow the displacement of the points of greatest stress to union of each to the other and only to horizontal or vertical joints logically with a better response to stability (Fig. 6).

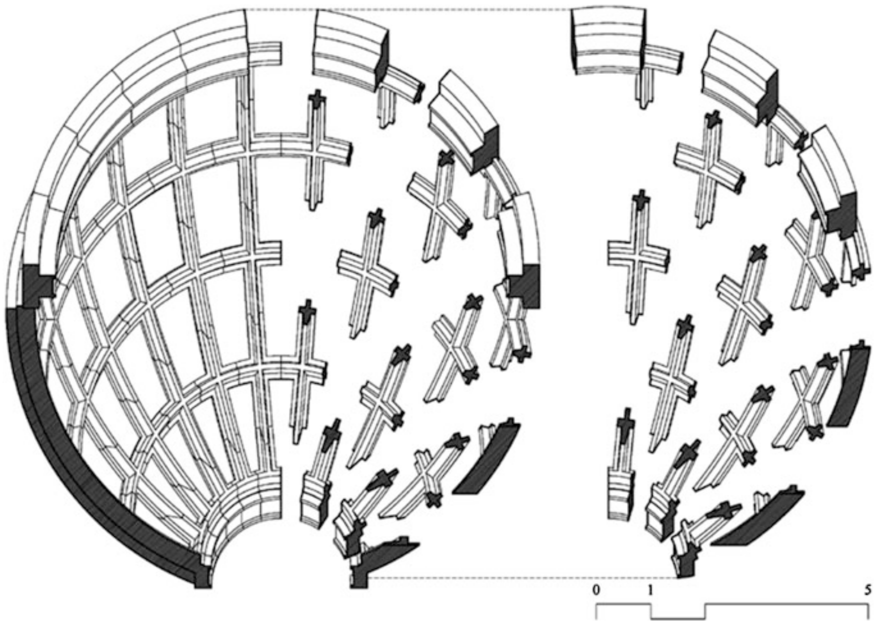

Fig. 6 Egyptian exploded axonometry of the cutting executive of the *ochavo de La Guardia*. Drawing by Antonio Estepa Rubio

3 Conclusions

To summarize we can tell that some of the cases developed by Andrés and Alonso de Vandelvira, both theoretically and through the building, were paradigms which meant a revolution in the way in which it was conceived and executed the architecture of its time. As well it evidenced, among other examples, the flexibility to adapt to general situations on specific and unique problems, as happens in La Guardia.

In this line, the solutions of the *bóveda de Murcia* and the *ochavo de La Guardia*, with all the variants contained in the manuscript of Alonso de Vandelvira, more or less complementary within a common area of influence, show how the discursive protocol of the time, supported by the rules of the metric geometry and the descriptive geometry, was able to respond to the demands generated by a new reformist spirit, inspired by the classic ideal, with a heavy building tradition rooted in the knowledge of trades.

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A Forensic Look to the Ruins of Saint Mary of Cazorla Church. Proposal for Virtual Reconstruction

Jesús Estepa Rubio and Antonio Estepa Rubio

Abstract The subject matter of the work is focused on reach a virtual reconstruction which allows getting more knowledge about the formal and physical features of one architectural space never finished. This idea is possible through the main constructive and geometrical points of the Architecture of Andalusian Renaissance. The target is to imagine how should have been the architectural space of Santa Maria de Cazorla, wich only exist some ruins of those unfinished works. The results allow knowing the emotional and physical sensations that somebody could have feel there, using a tridimensional virtual tour.

Keywords Vandelvira · Andalusian renaissance · Virtual reconstruction · Architectural display

1 Introduction

There are a lot of studies about the Architecture done into the several towns of Jaen shire, but noone is focused into study of the lost heritage that never was concluded.

Looking at the archaeological remains and the relics of any edifications, is possible to find their geometrical conditions, shape and volume; and then, helped by historical descriptions and other information collected, we could rebuild finally what at the time was up.

Making use new technologies we can set an analytical and deductive system that allows chaining data, completing as if it were an array, all nonexistent intermediate information. For the case of Saint Mary of Cazorla church, the analysis is even more complex and consequently more interesting, because the results of the methodological system used are distorted partially by other physical condition non

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related with the Architectural aspect, like its particular position and the relationship with Falcon's Mountain or the special situation that the building foundations are on the top the river basin.

This investigation takes a lost past and put it again into the society in the way of a document that, based in the studied data, rebuilds the part of lost heritage in our time, making use of informatics techniques instead of other possible procedures, because it does not produce changes and spoilage at the conserved rests.

2 Departure Points. Justification of Working Methods

If we make a cogitation about what means rebuild, we could fall into the error of trust than this idea is related with develop a material work in which physically we act in a historical building in order to remake a part that, more o less, was lost time ago. Nowadays, the reconstruction systems have changed, and it is because of understanding that the work procedure does not have to be related with matter, instead it can be based on a virtual reality that could be used to study the geometrical, spatial and phenomenological conditions that the building could have had in the past.

Keep is referred to the original status of one building, making all necessary actions and technical work: consolidations, supports, plasters, superficial treatments and cleanings.

Restore is referred to give back the original status of one building that was lost because of the time action, through interventions that, conserving the material and shape qualities, recover and update the historical, artistic and architectural values.

Reinstate is to make enable again one building for its original use that was lost and deserted time ago. Put in use a building is the best guaranty for the architectural integration and conservation in the future because it makes necessary to follow a maintenance plan.

But the virtual reconstruction is not similar to the previous actions we have mentioned. For the virtual reconstruction of a building, firstly a patient study is needed shredding the messages and shapes that show us the fundamental skills of its architecture and its singularity.

About the recuperation of buildings there are two different tendencies totally opposite: in one hand Violetle Duc who talks about the idea that restore a building is not only the maintenance, the conservation or to remake it up, instead of reestablish the total essence; in the other hand Ruskin's theory which prefer not restore.

The actual concept of historical heritage has accepted Ruskin's theory considering that the monument belongs to its creator and the next generations, but has forgotten the impediment they have for acting over it.

So then, those theoretical principles could be overlapped to generate new general considerations that, according with Madrid de la Fuente,[1] should be taken in consideration in order to make an acceptable reconstruction:

Every building or their conserved parts have to be restored in the same style they were made with, not only focusing in their appearances, also in their structures. If we consider the possibility that one building could have suffered modifications, it is not necessary to rebuild this modifications and neither the original status; the proper way is to respect the unity and the real concept of the building.

Is important not reproduce intermediate stages adverse to the solidity of the building although it is historically contrasted because is mandatory to respect the unity and the real concept of the building.

When we try to rebuild part of monuments that we do not know and do not have information or footprints about, the architect have to work choosing best materials and constructive techniques for the stability and solidity of the monument. Is important to propose only the actions and the restorations more similar and closer to the existing evidence.

Specifically we can define the virtual reconstruction like a graphical tool for the reconstruction of the architectural heritage in which, through the digital system based on documentary sources, the site evidences and other documents, it is possible a reinterpretation of the environment built but lost and maimed in the past. The virtual term is an adjective that shows the procedures different to the traditional rebuild in terms of methodology of work in which the digital representation is used as a tool, but the objectives could be the same in both techniques.[2]

The possibility of essays and proofs is not limited and non destructive, so it is very easy to compare several solutions derivative of the different possibilities and hypothesis developed during the stages of the research.

Definitely there are no doubts about the reconstruction virtual tools with digital systems make us have an accurate and scientific knowledge contributing with new ideas and research that will help to understand the geometric, spatial, historical and physical nature of the monuments.

3 Physical Description of the Geometrical and Spatial Features of the Ruins of Saint Mary of Cazorla Church

The first point we have to focus in, is the special position that the ruins have into their “semi-natural” and “semi-urban” environment. This hybrid relationship of spaces makes that the church is interesting, not only for the architectural values, understood as the concept derived from the building object related with its closer

[1]Madrid de la Fuente (2008).

[2]Rodríguez Alcalá (2004).

urban system, because furthermore is relevant the landscape aspects that organizes the visuals and the functionality in the square where the church is (Fig. 1).

Is a very relevant condition for the church trace, the special position with a boundary wall against the Falcon's Mountain, because it determines the constructive system for the perimeter walls and the geometric conditions of the trace, making certain asymmetries that characterize the personality of the interior space of the church. It is a natural conditioner that immediately impacts on the physical definition of an architectural fact and its operation within the urban scene (Fig. 2).

The plan of the church has a rectangular proportions misconfigured and are interrupted by the boundary wall against the Falcon's Mountain, which causes the longitudinal axis is fragmented on the perimeter into three segments: the first, longest, extends from the foot of the church until the start of the cruise, the second, is developed across the transept, and the third has a length equal to that of the sacristy and includes the space of the main chapel and Saint Christopher chapel.

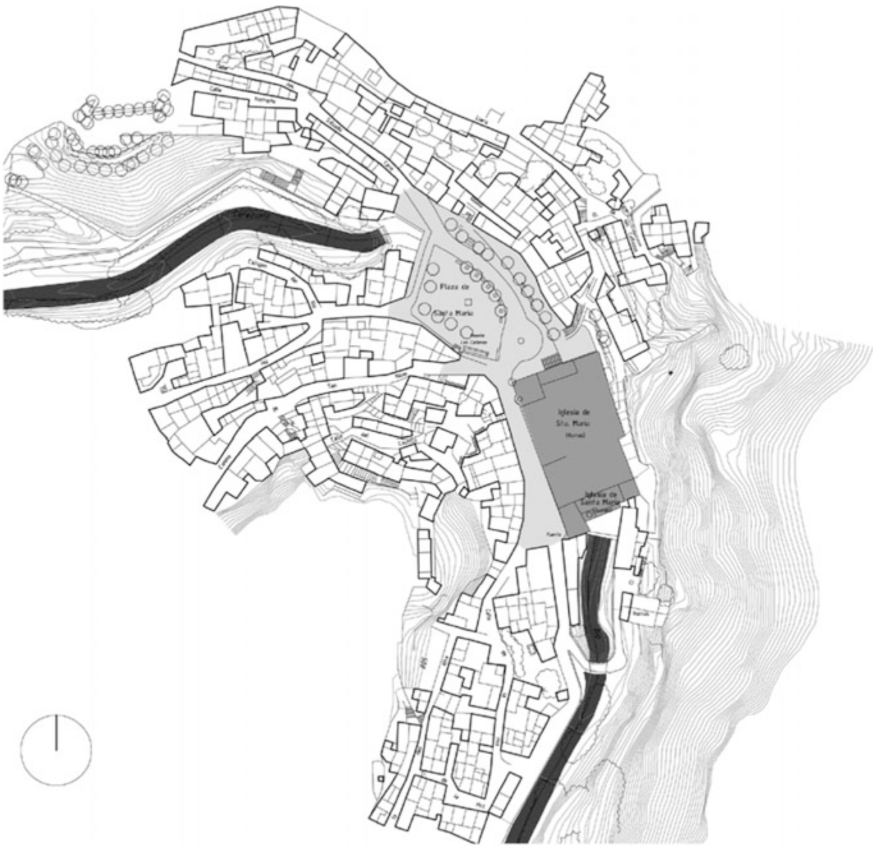

Fig. 1 Urban area surrounding the ruins of Saint Mary of Cazorla church. Jesús Estepa Rubio drawing

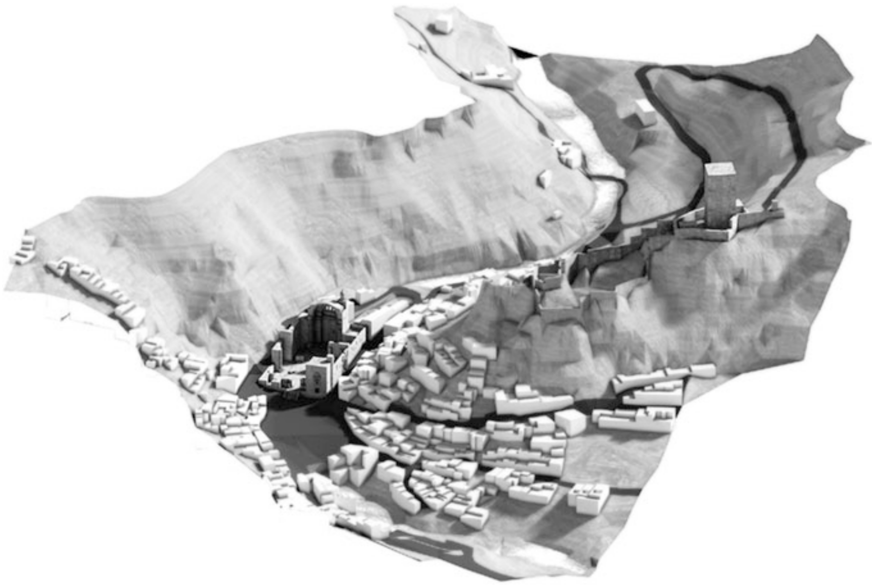

Fig. 2 Northwest axonometry of the urban area of the ruins of Saint Mary of Cazorla church. Jesús Estepa Rubio drawing

In the transverse direction, the plant is organized by three naves, two of them have equal width, and the central nave wider than the previous ones. Similarly, due to the asymmetry caused by the mountain, the nave located on the Epistle side (right side from the point of view of the faithful facing the shrine) is flanked by chapels along its length to reach the sacristy, except for the side door leading to the temple from the west on La Hoz street, while the nave located in the gospel side (left side) interrupts the sequence of chapels against the mountain.

The central nave is a much bigger proportion than the lateral naves, creating a longitudinal space perception that essentially starts from access by the main entrance at the foot of the temple and continues until the presbytery, which takes a square proportion because the cruise is formed by intersection with a transverse nave as wide as the central. It quickly leads to imagine a space resolved surmounted by a cover with a hemispherical dome.

The presbytery is in the same plane space, shallow and covered by a coffered barrel vault, which gives a dynamism unfettered regarding attention to the altar, giving it a sense of spatial hierarchy.

The presbytery eastern part is divided into two chapels, previously mentioned, on which appear shell windows in the tympanums. Under presbytery vault one Serlio's oculus window with a large, clearly linked style with the last period of Vandelvira's work (Fig. 3).

The general structure of the trace has important links with Jaen Cathedral, and on a smaller scale with San Isidoro church in Úbeda and the Assumption church in

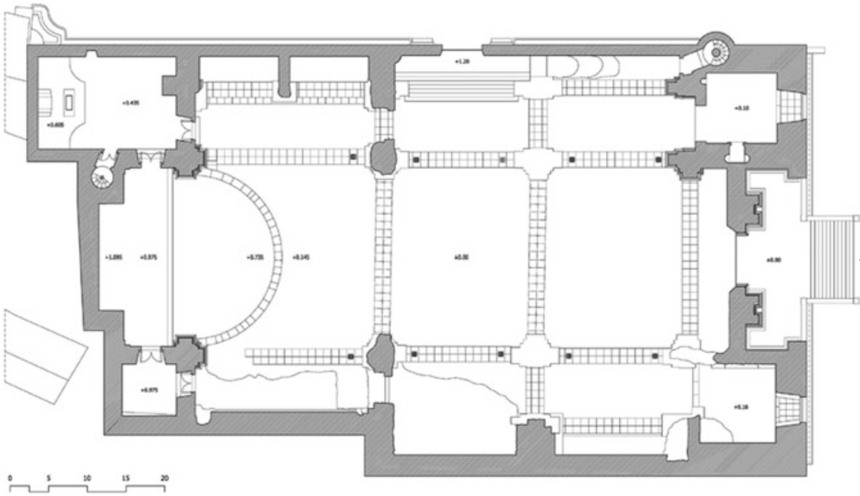

Fig. 3 Plant the ruins of Saint Mary of Cazorla church. Pedro Salmerón Escobar drawing

Villacarrillo in terms of proportions and formal organization. Galera Andreu also links its typology with the parish church in Santo Domingo convent in La Guardia, with which it must have a coincidence on date, at most a few years earlier.

The parts built during the sixteenth century should have been the perimeter wall, the presbytery, the entrances and the towers, leaving the trace projected by the start of the pillars and foundations, so that their use for worship be allowed while works continued; from here, maybe the original trace could have been altered, covering the presbytery and transept, but leaving the rest uncovered as a porch.

4 Urban Scope and Physical Environment, Determination of Envelope Volume

If the urban scope and the natural physical environment of the Falcons Mountain are abstracted as if it is a model, and insert the total body rebuilt of church of Saint Mary of Cazorla church, we can see the volumetric and visual power that acquires the monument.

This apparent feeling that the building has an excess volume, which makes it seem out of scale, is not unusual in Renaissance thinking. The geometric rotundity, the bombast and sometimes, why not arrogance are qualities of the Andalusian Renaissance sacred architecture that became manifest notably in construction.

Density, strength and challenge versus topographic problems show signs of imprinting of the building and the stubborn conviction that pushes the architect, challenging their own knowledge and even the technique of his time, to solve a constructive caprice with which had to give samples of power and sovereignty.

So it becomes clear in the rebuilt image the indomitable spirit of the designer, to the point that it can be glimpsed a reading of the impossible, it seems evident that the place where the building stands is, by the way, the most difficult and the less suitable from the point of view of the optimization of resources, by not only it fights against the Cerezuelo river flow or against the movement of water lines of the valley, but also looks as if intentionally the building push it against the Falcon's Mountain perhaps to expropriate a land that wants to own.

The building now, once reconstituted, recalls the importance of the divine presence in civil society and with it, the conventional idea of the time, to feel protected by a large and powerful God who helps and guides, where the church makes of meeting place and a place of communion (Fig. 4).

The building it makes present since a maximum envelope volume of 54′24 m long, 33′52 m wide and 24′60 m high, counting this to the height of cornices of cover and without considering the height of towers.

The largest ridge has a height, measured from de line of the eaves of 6.25 m, height resulting considering, knowing the minimum dimensions and thicknesses constructive to make that the cover works properly with respect to the covering of the vaults, a slope of roof cover plain of approximately 45%. In this way counting the height of the max ridge, the apparent contour of volume capable would measure a total of 30′85 m, which it is almost equivalent to a modern residential building between nine and ten floors.

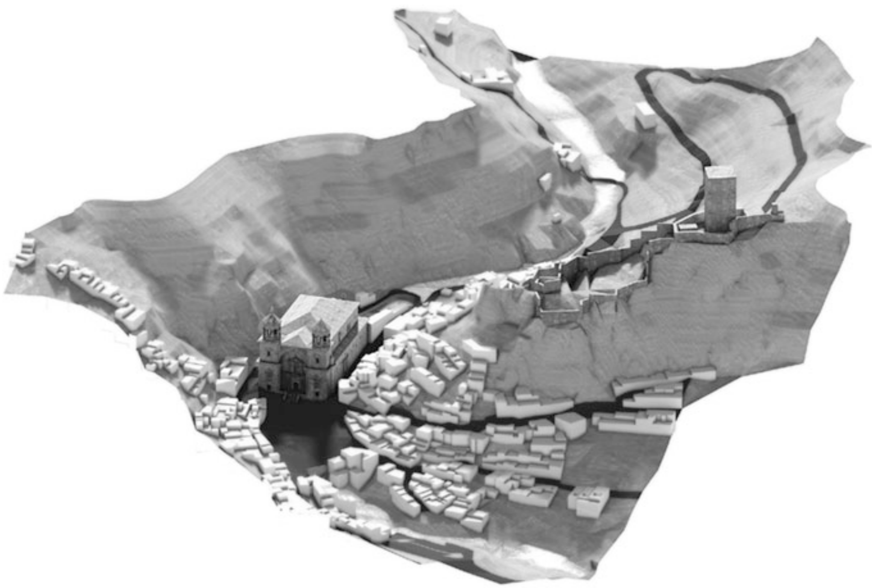

Fig. 4 Northwest axonometry of the urban area of the ruins of Saint Mary of Cazorla church. Jesús Estepa Rubio drawing

But besides this maximum apparent contour, we must take into account the vertical distortion produced by the towers and bell tower, because actually they will be which, to the perception of the human eye, defining the true vertical line which delimited the temple, although this does not have consequences for the interior space thereof. The towers 12′75 m exceed the line of the cover eaves, which means that the maximum length for the same, measure it to the point of intersection of the ridge of the octagonal bodies is of 40′30 m height, which roughly corresponds to a modern residential building between thirteen and fourteen storeys high.

Thus, the facade is structured to Saint Mary square is a perfect rectangle whose sides are related in proportion 6:5, that is to say, the height is 20% greater than the width, which helps with the visual correction that is lost by the vertical leakages, the perception of the facade, counted until the ridge of the towers, is captured by the human eye practically square.

The emergence of a large atrium closed by a triumphal arch at the foot of the temple, however helps to strengthen the verticality of the facade independently of the side towers. The arch defines a space that absence would make that the difference of alignment of the towers with respect to the wall box to grant them the title role in the visual facade. This resource, more stylistic and pictorial ensures the continuity of the perimeter path of the total volume of the building, no incoming or outgoing, resulting in a unique canvas that now stars on the scene of the square.

Having studied the ensemble of measures and the physical qualities of apparent contour of envelope volume, it is important to study the relationship between the physical volume of the church and the interior space, so that with it we may have criteria of its size, of the construction constraints and therefore the possibilities of lighting inside the temple (Figs. 5 and 6).

The corporeality material defines dim interiors, so the proper relationship between the bearing capacity of the construction material, in this case stone, and the constructive system that used this material, results a different wall thickness, which

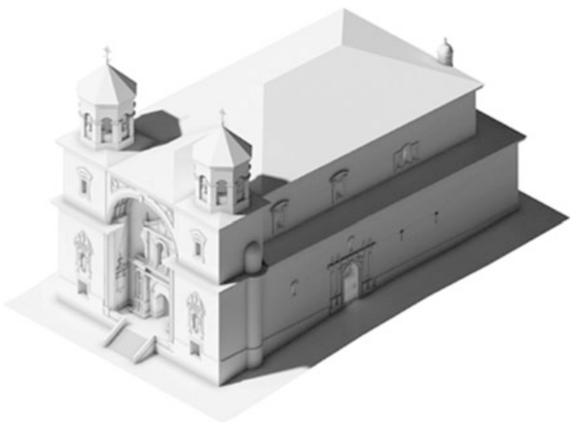

Fig. 5 Envelope volume of the virtual reconstruction of Saint Mary of Cazorla church. Jesús Estepa Rubio drawing

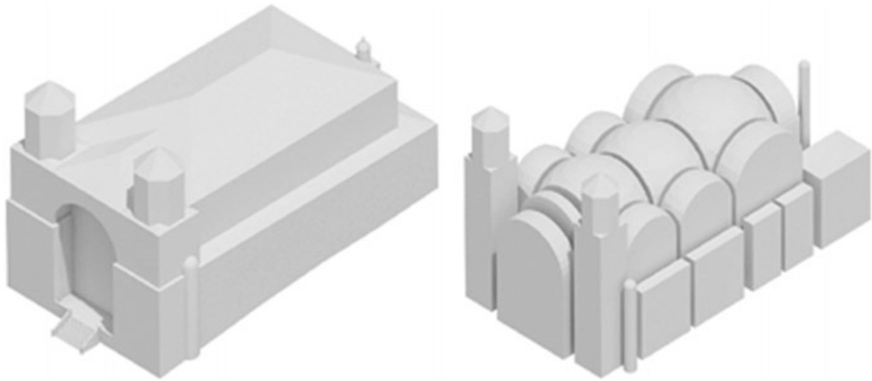

Fig. 6 Interior and exterior volumes of the virtual reconstruction of Saint Mary of Cazorla church. Jesús Estepa Rubio drawing

condition the passage of light therethrough and therefore the amount of light intensity that characterizes this space.

This quality will require the use of holes with which, according to the designer, the interior of the temple qualify. That is, those places that are highly exposed to light, due to the smaller size of the bearing wall or position of holes, they will inevitably be more and better crafted in quality material or ornamental than those that are in darkness, as the human eye will be unable to realize substantial differences in the geometrical shapes determining constituent.

The relationship of interior space to envelope volume of building is a fundamental condition for the understanding and perception of such a space. Determinants such conclusions regarding the placement and sizing of the holes to be opened in the walls of the building is extracted.

Looking at the picture we also see the enormous spatial continuity that exists inside the temple, as the different spatial sets that constitute the naves and the side chapels, are only minimally fractured by a slight bearing structure in which main arches of the ribbed vaults and cruciform pillars are characterized by their lightness and thinness. As shown, the spaces are concatenated, this quality very typical of Andrés de Vandelvira style and derived from the typological development of the structure of the plant room, because by having the naves equal height there are no visual prevalence of any space over another, thus ensuring that the whole is understood as a single homogeneous entity.

This results in long interior perspectives leaks as the eye can only cover small areas of space, forcing in a way, to have to wander inside the church to discover it in depth and to deal with whatever happens in its interstices.

Fig. 7 Overlay of interior spaces rebuilt on the ruins of Saint Mary of Cazorla church. Jesús Estepa Rubio drawing

5 Conclusions

The next pictures, in a conclusion way, make a summary of the content developed in the research and convincingly illustrate the final results obtained (Fig. 7).

The virtual reconstruction therefore, makes possible to arrive at a perception almost as detailed and sensitive as a real photograph of interior space. Therefore, it allows apprehending the space that should have existed in the case of Saint Mary of Cazorla church had been completed; and consequently feeling emotions, not only perceptive but also phenomenological, environmental and weather, which are only possible to understand the architectural space from within. This technique justifies the knowledge of the heritage from the sensory and the space that facilitates the understanding of it without having to be physically built (Figs. 8 and 9).

These techniques open new possibilities for working on our architectural heritage, through trial and error tests that do not produce a single shred of

Fig. 8 Virtual recreation of the interior space of Saint Mary of Cazorla church. View from the foot of the temple. Jesús Estepa Rubio drawing

transformation of the monument, it can approach for a successful and increasingly accurate knowledge about it. These sophisticated tools for monitoring and evaluating the construction and the space, give to the architects a new dimension to the approach to ruins and remains of buildings.

The following code allows us to view on-line an interior panoramic perspective of the building, rotating 360° around a point located in the center of the church. With this picture is possible to reach a global understanding of the quantity and quality of the tested space, scale, shape, and, in general, all those parameters that have helped to make possible the virtual recreation (Fig. 10).

Fig. 9 Virtual recreation of the interior space of Saint Mary of Cazorla church. View from the central nave. Jesús Estepa Rubio drawing

Fig. 10 QR code to display online the virtual recreation of Saint Mary of Cazorla church. Jesús Estepa Rubio drawing. Available on the World Wide Web: http://www.pixeet.com/pano/NQSWMPSH

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Manuel Gomes da Costa, a Universe in Sketches

Miriam Lousame-Gutiérrez

Abstract The exhibition held in 2009 in Faro, Portugal, about the work of Manuel Gomes da Costa (1921–2016), "MGC, moderno ao Sul", had among the exposed material some sketches of the architect dating from 1951 and 1952, when he began his professional career. Twenty-eight formats with heterogeneous thematic calligraphic drawings representing a major source of information for the analysis of the architect's work: their ideas, concerns, aspirations, tastes, influences. They reflect a process of research initiated at an early stage of his career that will pay off later and will result in his built work, mainly in the first two decades of his professional work, between the 50s and the 60s.

Keywords Manuel Gomes da Costa · Modern movement · Algarve 1952

1 Manuel Gomes da Costa, a Universe in Sketches

Manuel Gomes da Costa (1921–2016), is one of the algarvian architects responsible for the upcoming of the Modern Movement in the Algarve. His numerous and important work, developed outside the main historiography, has been rarely spread and therefore is practically unknown.[1] Gomes da Costa was educated in Porto. At the beginning of the 50s his architecture in the Algarve supposed a break with the historical, academic models installed by the political regime. It characterizes by the use of a modern vocabulary of formal, constructive and structural elements which

[1]In 1953 the magazine *A Arquitectura Portuguesa e Cerâmica e Edificação* publishes one of the first house built by Manuel Gomes da Costa alongside houses from other architects: Viana de Lima, Fernando Távora, Rui Pimentel, Eduardo Matos, Mauricio Vasconcelos and Manuel Laginha. Since then until the publication of an article by Fernandez in 2006, no further publications about the architect have been found.

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allows him to establish a recognizable and frequently imitated style.[2] His work shows a balance between the compromise for a functional, standardised architecture, serving the society and an architecture that pays special attention to details and leaves no aspect aside.

The exposition about the work of Manuel Gomes da Costa "MGC, moderno ao Sul", held in 2009 in Faro, Portugal, showed amongst the exposed material some sketches of the architect dated in 1951 and 1952, the moment when his professional career began.

Twenty-eight formats with calligraphic drawings of heterogeneous themes represent a major source of information for the analysis of the architect's work: his ideas, concerns, aspirations, tastes and influences. They reflect a research process that began at an early stage of his career and that would later bear fruit and result in his built work, mainly during the first two decades of his practice, in the 50s and 60s. They include a repertoire of situations that mixes perspectives, dihedral views, scales, interior details, furniture design, decorative elements, fonts, materials, textures and colors. The arrangement, the order and the incidence in some drawings, also show a methodology, questions about his personality and his desire to provide southern Portugal society with architectural models that were coherent with the modern discourse. His work represents today a testimony of modernity that is particularly evident in places like Faro, where hundreds of buildings have contributed to shape his current image, many of them reflecting the ideas embodied in the sketches (Lousame 2014).

The communication aims to deepen the relevance of the research process performed by Gomes da Costa through his drawings, establishing correspondences between these drawn architectures, some of his built works and modern architecture publications of that moment.

2 Intentions of an Architecture in Paper

"If the drawing is a result of thinking, also drawing is the necessary instrument and material with whom and where thinking happens, because drawing is not as much a part of representing as of acting and conceiving" (Quetglas 2008, 32). The drawings were saved by Mr. Duarte Infante from the Silva book shop in Faro, where Manuel Gomes da Costa used to buy books and spend some time drawing.[3]

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[2]Although modern architecture was rather unusual in the Algarve until mid-century, since the early decades of the twentieth century, some fishing towns like Olhão were associated by its vernacular building traditions to the avant-garde's formal stereotypes, identified as Cubist architecture (Agarez 2012).

[3]This information was provided by Gonçalo Vargas, the curator of the exhibition MGC, Modern ao Sul, who also supplied the research of my doctoral thesis about the architecture of Manuel Gomes da Costa with some of the exhibited material, amongst which are the drawings object of this communication.

They are “spoken” thoughts made by and for him, but they seem to have been made in order to transcend rather than as a simple manifestation of ideas. They also seem to have been made to be explained, to assume interpretive shortcomings that a potential partner could have in the still almost untouched context of modern architecture.

3 Overlapping and Mixing

The architecture of Manuel Gomes da Costa is characterized by being lightweight, emphasizing surfaces, different layers and filters. These aspects are described in the sketches and sometimes they also show a way of drawing. Although he tends to use overlapping layers in his architecture, in his drawings they are rather an exception than a methodology. In the case of Fig. 1, the format is used as a palimpsest in which some drawings are reflected on top of the previous ones or on traces shining through from the other side, showing the character of immediacy of a sketch. In the other formats, it is not improvisation but the fact that short-lived drawings are made with such detail and care, stands out as a feature of the perfectionist personality of Manuel Gomes da Costa.

The diversity of views, scales and themes shows a set of theoretical ideas, as well as a physical mixture of materials and intensities of lines, that is translatable in his buildings to the mix and arrangement of the different elements, especially on the facades.

4 Abstraction

The interpretative complexity that introduces the represented architecture is evident mainly in the elevations. Despite their expressiveness, the lines do not provide enough information to understand which and where the hollows in the facade are, if it is build by more than one front plane, if there are elements that overhang or what is opaque and what is transparent. The experience with other examples of his works offers the possibility to suppose that the lines correspond to elements located in at least two different planes, the exterior wall and the facade of the terrace, or even three, if it is considered that there is a recessed head frame. The presence of human figures is an important key of understanding. The proposed architecture is largely unknown and in this sense, the abstraction of some drawings corresponds with the abstraction of built architecture, mainly in the early work, in which the codes of modernity have not been assimilated yet.[4] In 1953, the magazine A Arquitectura

[4]According to the words of José Carlos Barros in an interview for the digital newspaper Varlavento, related with the exhibition about MGC: “The first work caused some problems and was referred to as a miracle in Faro for its innovation and singularity, so that the civil servants of the Faro Council were unable to deal with a foreign object that was intruded in the antiquated style”.

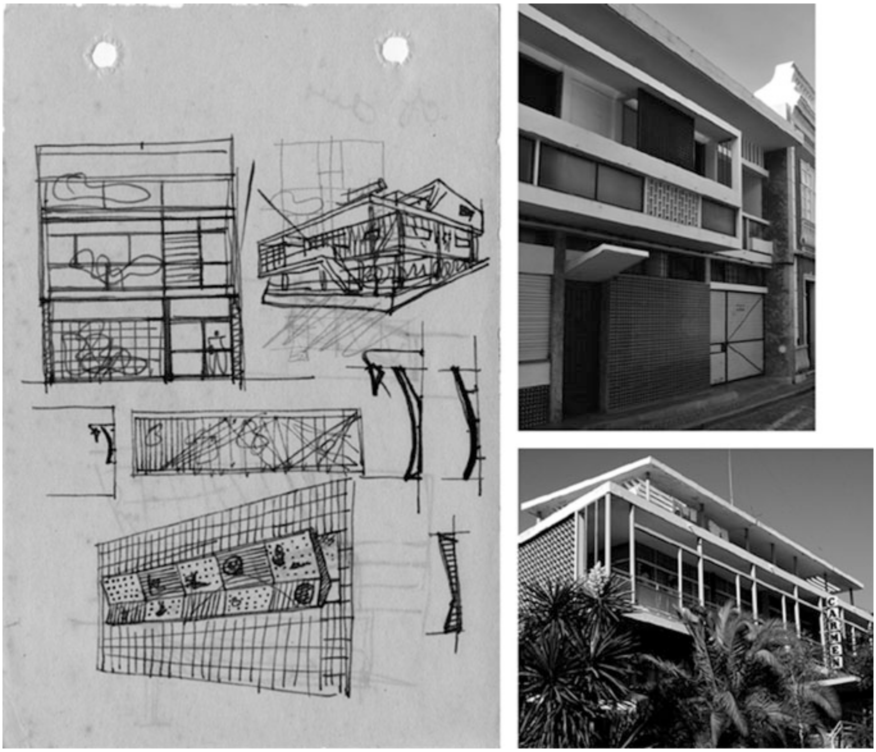

Fig. 1 Manuel Gomes da Costa: sketch on various topics; Casa Neves in Tavira (1960); Casa Alfredo Gago Rosa in Faro (1955)

Portuguesa e Cerâmica e Edificação describes the first work of the architect in Faro as a miracle: "The house of Gomes da Costa is clear, elegant, very sincere, full of freshness and imagination. It would be exceptional in the new Lisbon built by architects, but in Faro it is a miracle" (Fig. 2).

5 Perspective and Vegetation

Representations of elevations are usually accompanied by a picture in perspective. Gomes da Costa uses the conical perspective as a spatial research method to clarify and supplement ambiguous situations arising "from the abstractions of orthographic projection", (Evans 2005) as well as a tool to be understood by a possible client or builder.[5]

[5]In a personal interview held with Manuel Gomes da Costa in Portimão in April 2015, he emphasized the importance of the perspective drawing to explain the project during the building process.

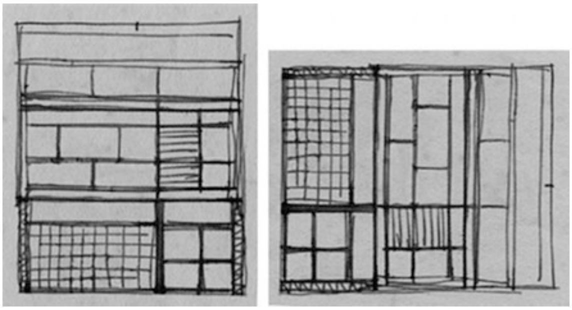

Fig. 2 M. Lousame Gutiérrez: elevation and elevation rotated. Manipulated fragment a sketch of Fig. 1 without vegetation or people

Depending on the project, the perspectives are made in different scales. In the case of isolated houses, they are small drawings in which the represented volume is the most important aspect, even when it is lacking of context. They are like study models that can be rotated "in orbit" in order to provide different views of the buildings. The facade perspectives that are inserted in a minimum urban context or representing scenarios indoors, have a different character. In these cases the realism prevails over the point of view and the drawings increase in size occupying almost the entire format.

Combined with the use of perspective and human figures the vegetation is another sign that makes the drawings more understandable. It is used as an aid that implies the existence of pots and flowerbeds as construction elements. Sometimes the conscious desire that the vegetation should be part of the architecture, even conditions its form and structure. Figure 3, shows a hole that is opened in a terrace to allow a tree to grow through. That very particular detail makes the observer remember the hole designed by Le Corbusier in the L'Esprit Nouveau pavilion for the International Exhibition of Decorative Arts in Paris in 1925, which Gomes da Costa interprets in several of his works (Fig. 3).

6 Color and Shade

Manuel Gomes da Costa uses light as a design element. Arguably he projects an architecture capable of being perceived through the shadow it casts on itself: Shadows of lattices are stamped into the walls, pergolas are tearing the ground, cantilevers are nailed on the facades. However, they are barely graphed in the drawings. Only in the perspective of Fig. 6, the shadow of the cantilever is shyly represented on the glass facade of the restaurant. Although it is performed with a line shading which suggests little technique or carelessness in the representation, by marking only the cantilever and obviating the rest, it affirms the existence of an clear intention to achieve the desired effect.

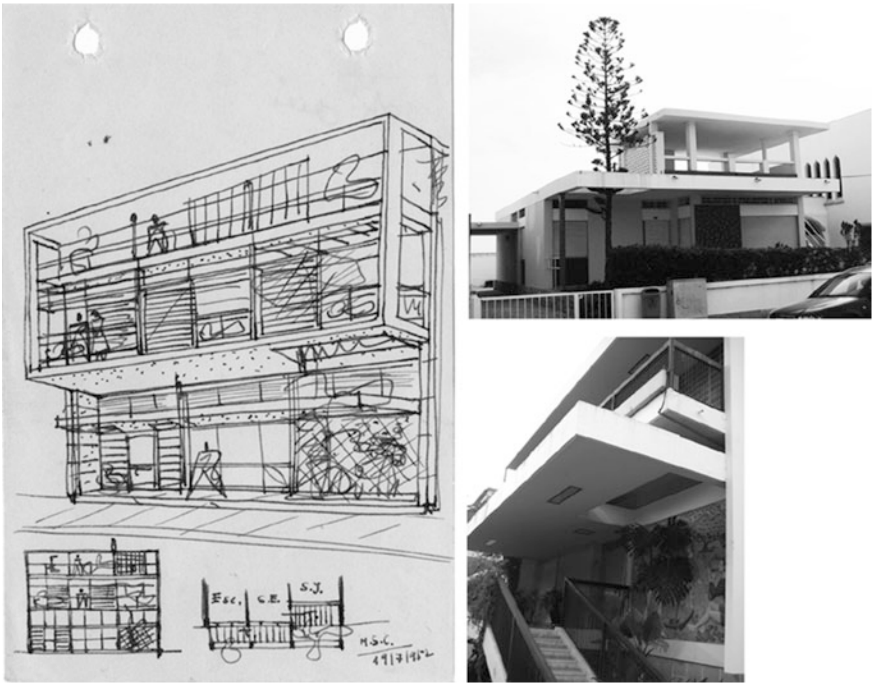

Fig. 3 MGC. Perspective (1952); House on the beach in Faro (early 50s); House on Rua Berlim in Faro (late 50s, early 60s)

Something similar happens with the exceptional use of color that can be found only in one perspective drawing of an interior. It is applied with a pencil through shadings and quick strokes that fail to become stains. Color powers materiality, although because of the ink drawn textures, it is not an essential information. The used colors are neutral and cold grays and greenish blues in large areas. Only pink, which is limited to small objects such as lights, stands out in the composition. Gomes da Costa chooses unusual colors that print a touch of unreality and fantasy in contrast to the supposed realism of this type of perspectives.

In his built work, color occupies an important place and it is applied in a manner, similar to the described drawing. Great outdoor surfaces are usually white or painted in soft and neutral colors, while the points of intensity appear in controlled areas like tile panels in significant positions, usually located near the entrance, or like metal profiles and other specific elements of the facades.

7 Approach to a Working Methodology. Division and Grid

In the 28 formats that have been studied, some are dedicated to the same projects, showing different phases and versions of the design, that allow to achieve information about the work-process and the ideas that have been adopted or discarded. In Fig. 4 it is possible to follow the development of a dwelling. Even though it does not correspond with the architect's known works, it can partially be identified in projects that have actually been built. It seems as if the idea had been divided and spread amongst posterior works in a process that resembles an inverse collage.

The drawing of the square floor plan and the almost cubic volume at the beginning makes believe that Gomes da Costa approaches this project from the point of view of a unique volume, described by Le Corbusier and tested in dwellings like the Villa Stein (1926–29).

Over the polyhedron, a grid of orthogonal lines is drawn, that divides it in smaller volumetric units, which sometimes are subtracted in order to form patios or moved in order to form terraces. This process of disintegration of the initial volume, raises a topic which Gomes da Cost repeatedly touches during his professional career. It is the topic of the transitions between outside and inside. Intermediate spaces are the protagonists within the variety of the formal and constructive repertoire, that characterizes him: lamellae, perforated walls, frames framing outdoor spaces, lattice and sliding panels. They conform different intensities of protection, that break with the image of the compact volume and generate a lighter and more dynamic architecture (Fig. 4).

The Casa Tengarinha in Portimão, finds itself amongst the projects that materialize the ideas represented in these drawings, with the proper modifications that implies the translation from a drawing to a built work (Evans 2005). In one of his first assignments, the rehabilitation and extension of a holiday house on the beach, that has already vanished, the volume of the living area moves to the outside, forming a porch oriented towards the beach. A similar configuration is found in the perspective drawing between lines (Fig. 4: drawing in the centre of the upper right format). In another project, realized on the beach of Faro, the empty volume of the ground floor is extended by a pergola of lamellae, which reminds of the one shaded in the floor plans of the drawing. In all of them there are additional lateral stairs, parallel to the façade, which lead to an open space, a patio, that has to be crossed in order to get to the house, like in the previously cited Villa Stein, which seems to be one of the inspirations of the project. The promenade obliges to change direction various times and with it the perspective and the view, before getting to the inside. The idea of the visual promenade is emphasized in the house that the architect builds for himself in Faro; as well in the lateral access which divides the dwelling from the studio, as in the principal entry, that is reached by crossing a ramp, covered by a pergola (Fig. 5).

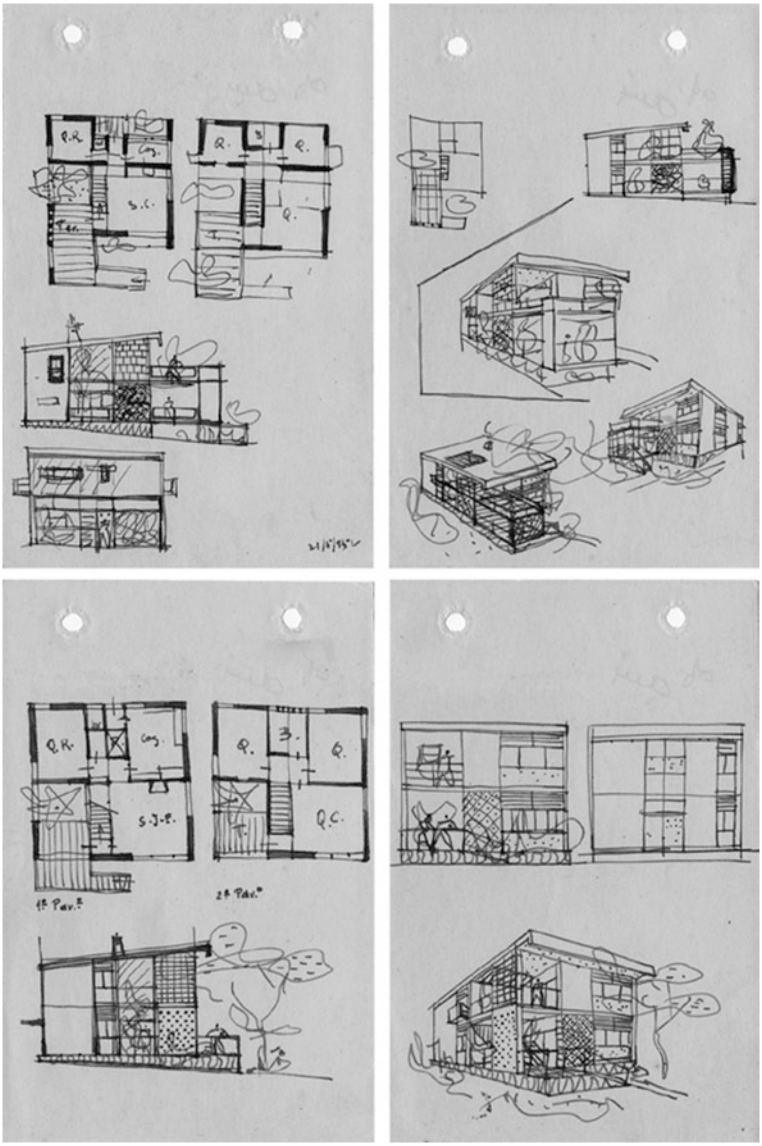

Fig. 4 MGC sketches of a dwelling project (1952)

8 The Communication of Architecture. A Graphic Story

If the previous example treats the dwelling like an object, which is manipulated and moved in order to have one view or the other, in the case of the interior spaces the methodology of design and narrative of the project are very different. Amongst the drawings are the projects of the lobbies of two restaurants.

Fig. 5 MGC. Casa Tengarinha in Portimao (1952); House on the Beach in Faro (1959); Architect's house in Faro (1966)

The first example has a vision that could be described as cinematographic because of its introductive images which reminds of a comic or a graphic story. The architecture is thought and drawn at times from the point of view of the narrator, at times from the point of view of two persons who participate like real actors over three scenes. In the first picture that is more important in size, the couple is standing in front of the façade, with which it shares protagonism. The shading of the two persons is more intense than in the rest of the image and like the patterns of the woman's dress, it expresses a certain proximity to the narrator.

In the second scene, the man has entered in the lobby while the woman is waiting outside, behind the glass at a lower level. This Situation in which each person is located on one side of the building, is expressed newly with the help of the shading, that disappears in the woman. From this perspective the entrance is shown and the structure of the wall, with an exposition object attached to it, is described with detail. The stairs are only insinuated. They don't have importance in this view. In the third scene the narrator disappears and with him the perspective. The image is told in first person directly by the woman. It shows her vision from the exterior through the window. Her regard is directed towards the back wall, intercepted by the silhouette of the man—probably his back—looking at the same wall on which the true protagonist of this view is located, the panel of tiling.

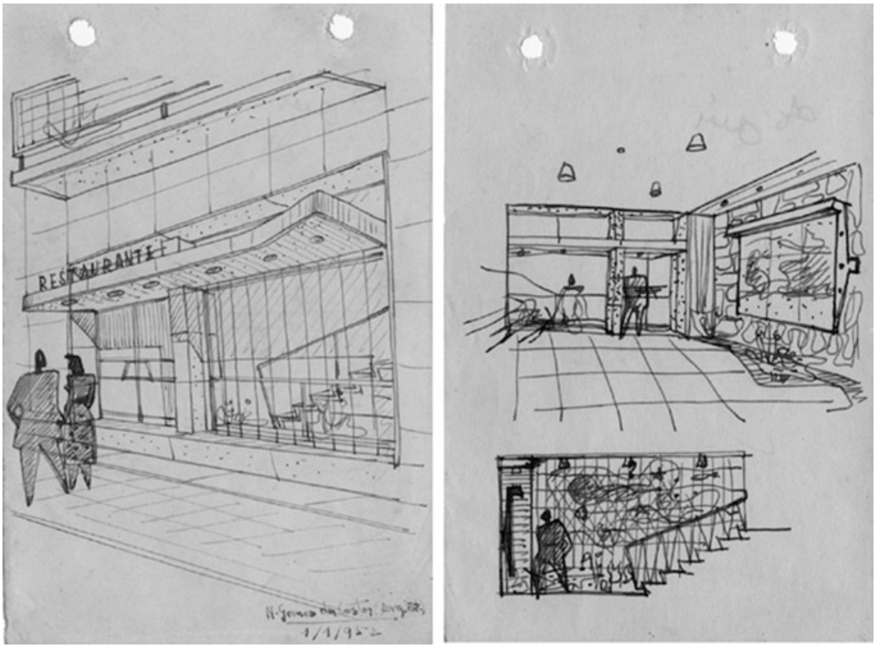

Fig. 6 MGC. Sketches of the Project of a restaurant (1952)

The frontal position should have created a central conic perspective of the space, but Gomes da Costa decides to represent this view, as if her sight would pass through the glass window and would realize a section through the stairs, suppressing the information of the plane of the exterior wall, that was already shown with sufficient detail in the previous drawings. This way, the architect narrator transmits different views and details of the proper space, using his view and the one of two persons who are moving within this space and are regarding it (Fig. 6).

9 The Magazine "Architecture" and Other Influences

The acquisition of "Arquitectura" by the ICAIT group in the year 1946, edited by João Simões, provoked a turn in its content from a conservative view towards a vision more open to modern reflection (Milheiro 2008). In this line it develops its function as one of the principal media of diffusion of architectural modernity in Portugal.

The divulgation of architectural competitions captures a big part of its content. In the number 38–39 of May 1951, it publishes the results of a competition of the brand Lusalite, in which the architect Jose Rafael Botelho wins the first price.

The similarity of two of the winner's projects perspectives and the drawings that Gomes da Costa makes for the second shop, leaves little room for doubt regarding the influence that they exerted in the design of the architect, above all in the election of the materials for the coating of the roof.

The exaggerated expression of materiality and the abundance of decorative motives—some of naïve character—may lead to think that the drawing of Gomes da Costa (it belongs to a series of five) has been realized in a random, capricious way. They are without any doubt the result of a process of investigation of materials and existing brands on the market, like the corrugated ceiling plate, similar to the one produced by Lusalite, or the recessed lights by Taquelim, as found in the only written annotation in Fig. 8. Regarding the furniture, it is the proper architect who signs responsible for the design of the chairs, tables, showcases, knobs and even the typography of the sign of the shop Costa Doiro. The different versions of chairs that he realizes respond to an exhaustive geometric design. Amongst the different models, a little perspective drawing, found on the second format of Fig. 8, especially reminds of the W Chair by the Argentinean Architect César Janello, published in the magazine Nueva Vision in 1951.[6] During his professional career Gomes da Costa would design furniture and mosaics integrated in the projects of some of his non-residential buildings, like the Casa de retiros in San Lorenco del Palmeral, the Cooperativa Agricola in Santa Catarina da Fonte do Bispo or in dwellings like his house in Faro (Figs. 7 and 8).

10 Conclusions

The drawings are a reflex of the personality of Manuel Gomes da Costa: interested in the details, methodical, imaginative and perfectionist. They prove his groundbreaking and courageous attitude to the profession, that led him to implement his ideas and concerns, mainly as an architect but also as a furniture designer, graphic designer and designer of fonts and mosaics. They show his confidence in the "modern project" and in drawing as an effective tool to express ideas and conceive architecture, from the moment of his inception as an architect.

A transmutation from the themes and shapes drawn to the built architecture is observed. However, essential aspects in the perception of his buildings as color and shadows, are practically ignored in these sketches. They focus on describing objectively rather than in the transmission of a subjective expression, that is condi-

[6]In 1947 the production of the W chair for the AA Style catalog began in Paris. In 1951 it was published in the first issue of the argentinian magazine New Vision as Chair Janello. In 1955 it reappears in the number 6 of New Vision on the inside of one of the bedrooms of the Curutchet house, named W chair.

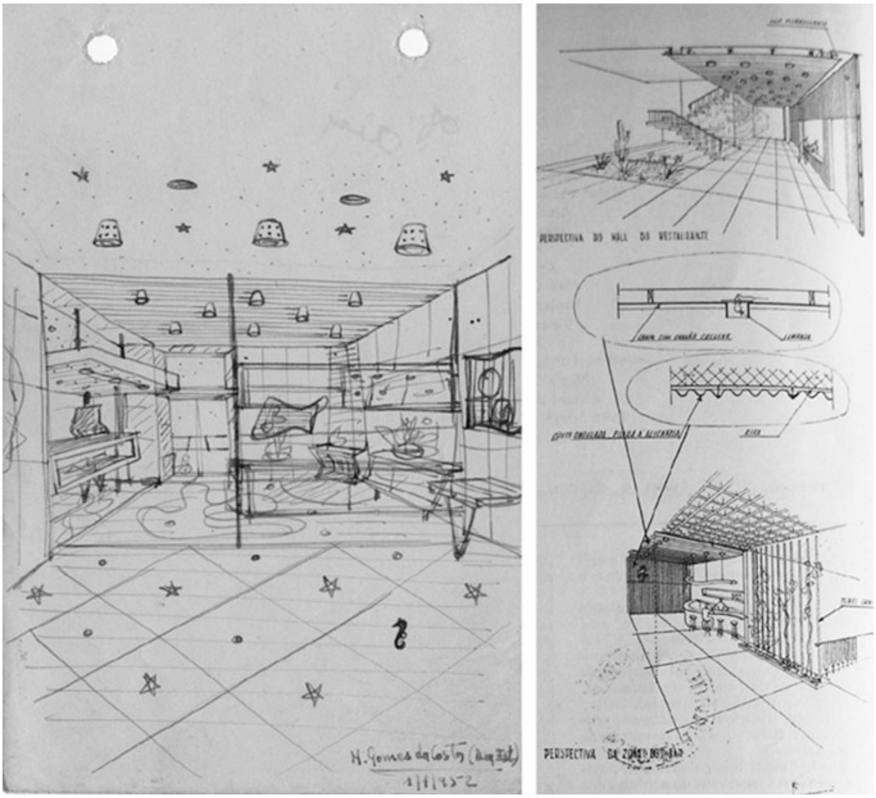

Fig. 7 Sketch in perspective of a shop of MGC (1952) and perspectives of a project of José Rafael Botelho (1951)

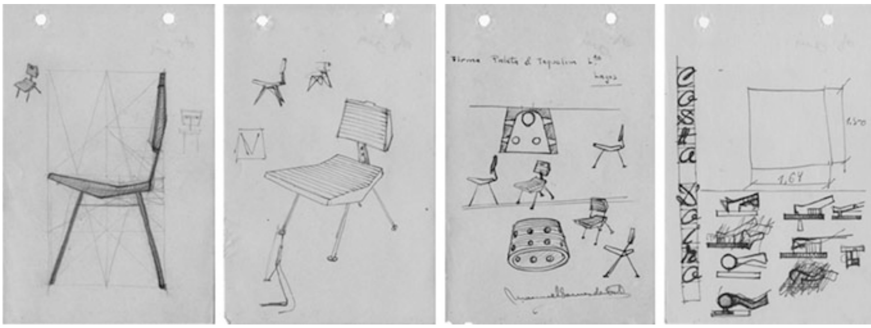

Fig. 8 MGC. Sketches of chairs, light, sign and knobs

tioned by the orientation or context. Both are almost entirely absent in his sketches. The analyzed drawings are moving between the abstraction of the two dimensions, in which the architecture is concise and summarized as direct translation of the architect's thought, and a more figurative "language" associated with the perspective and the narrative of the idea.

The research carried out by Manuel Gomes da Costa, influenced by publications and catalogs, played a key role in the conception of his designs. In this sense, the close relationship between the initial drawings and some works built even several years later, is surprising.

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Graphical Reconstruction of the Historical Buildings from the San Francisco de Borja Fontilles Sanatorium

Jorge Llopis Verdú, Francisco Hidalgo Delgado, Jorge Martínez Piqueras, Rafael Marín Tolosa and Eduard Baviera Llopez

Abstract This paper explains part of the work being carried out as part of *the San Francisco de Borja Fontilles Sanatorium. Analysis model for the comprehensive recovery of sanitary complexes with heritage value, research project*, funded through the *National research, development and innovation programme geared towards the challenges faced by society*. This paper aims to show the graphic documentation obtained, using the very latest photogrammetric technology that not only allows technicians to reconstruct the image, but to use augmented reality technology, which enables active immersion through the use of modern virtual reality technology.

Keywords Graphic modelization · Heritage · Fontilles · Virtual reality

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1 Leper Colonies. Sites with Both Tangible and Intangible Heritage

Facilities used to isolate and treat patients suffering from leprosy and other infectious diseases, *lazarettes,* possess a singular reminder of an entire period of European history, a period marked by the efforts of scientists to fight against diseases associated with poverty, and the social and cultural exclusion of sufferers of these types of diseases. Facilities where the ill were "isolated" from society, immersed in self-sustaining facilities which, over the course of time, developed into micro societies scattered across the whole of Europe and which rebuilt the same social structures and social habits as those on the outside.

Although there are historically documented cases of leprosy dating back to ancient times, it was not until 600 AD that the first lazarettes first began to appear in Europe. The first known leprosarium in England was the *Blyth Leper Hospital* in Nottingham, and these were so numerous that by about 1300, it is estimated that there were a total of 19,000 establishments across the whole of Europe. The first leper colony in Spain dates back to 1067 in Palencia, founded by Rodrigo Diaz de Vivar, El Cid, while the *Hospital de San Lázaro* in Seville was founded in 1248 and remained operational all the way through to the 1930s. It was also the template used for hospitals that were later founded by Spain in its colonies in the Americas (Fig. 1).

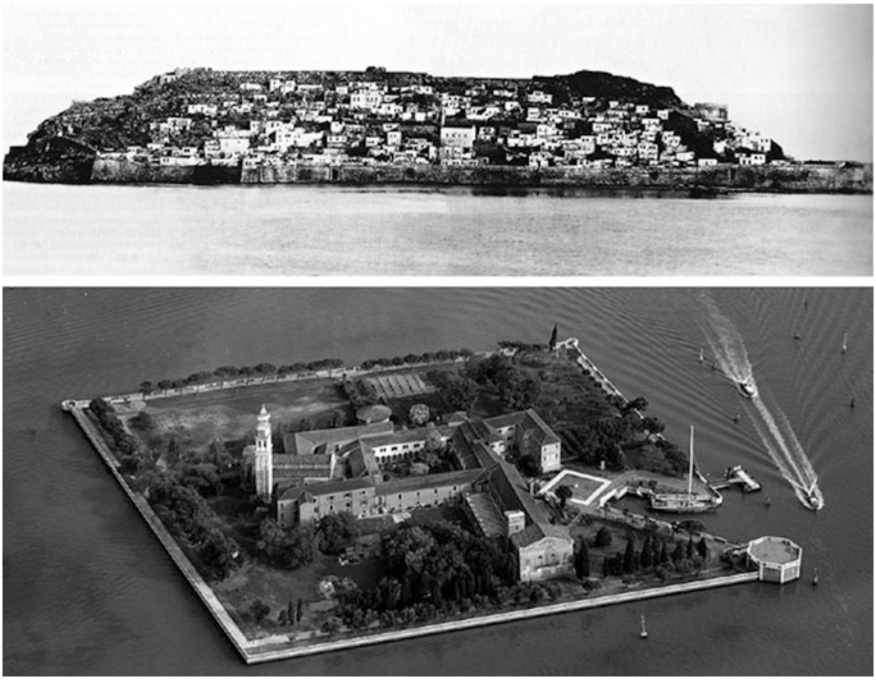

Fig. 1 The isolation of the disease: Spinalonga Island (Crete) and San Lazzaro degli Armeni (Venice)

The facilities began to evolve at the start of the 20th century, becoming colonies that aimed at mitigating the forced isolation of the sick, by creating medical compounds that were designed to be tiny, enclosed, self-sufficient cities. This was the case for the *San Francisco de Borja Fontilles Sanatorium* in Alicante (Spain), the San Martino Leprosy Hospital in Genoa (Italy), the St. Jørgen Hospital in Bergen (Norway), la Leprosaria Nacional Rovisco Pais (Portugal), the Tichilesti Leper Hospital (Rumania), and the Spinalonga Island in Crete (Greece), which in 2012 went on to form part of the *International Coalition of Historic Sites of Exclusion and Resistance*, with the medium-term aim of being added to the list of UNESCO designated World Heritage Sites.

This paper presents some of the work carried out as part of the *San Francisco de Borja Fontilles Sanatorium. Analysis model for the comprehensive recovery of sanitary complexes with heritage value, research project*, funded through the *National research, development and innovation programme geared towards the challenges faced by society* (HAR2013-42060-R), which in collaboration with the *International Coalition of Historic Sites of Exclusion and Resistance*, aims, using the Fontilles Sanatorium as a model, to develop new graphical interpretation methodologies to value the cultural heritage assets, both tangible and intangible, of these historic sites.

2 The San Francisco de Borja Fontilles Sanatorium

The Fontilles Sanatorium was founded in 1905. It has an extensive history of construction work, having undergone a number of changes and adaptations over the years, so that currently it comprises a group of buildings from different periods and with distinct architectural styles, which includes, in addition to the clinics, pharmacies, laboratories and other buildings used specifically for medical purposes, separate medical and residential buildings for men and women, buildings specifically for sick families, a theatre, a chapel, washhouses, refectories and even its own cemetery, spread out over a valley that occupies some 73 ha of low brush. The colony was completely surrounded by a 4-km-long and 3-m-high wall, used to isolate the colony due to the terror that the mere mention of leprosy might cause to the outside world at that time.

As with the rest of the colonies, life was structured around the medical treatments, but in an attempt to make the day to day lives of the sick as normal as possible, a whole series of activities were devised to “replicate” wherever possible life on the outside (Comes Iglesia 2009). Carpentry workshops, maintenance tasks for the upkeep of the facilities in addition to farming in the vegetable gardens within the enclosure, provided some degree of normality and led to a slow but relentless transformation of the landscape that gives us the image and structure of compound that is seen nowadays as a reflection of how life went on within its walls (Fig. 2).

As a whole, the architectures found at the Fontilles Sanatorium are modest, unassuming structures, built using limited material means, in keeping with the

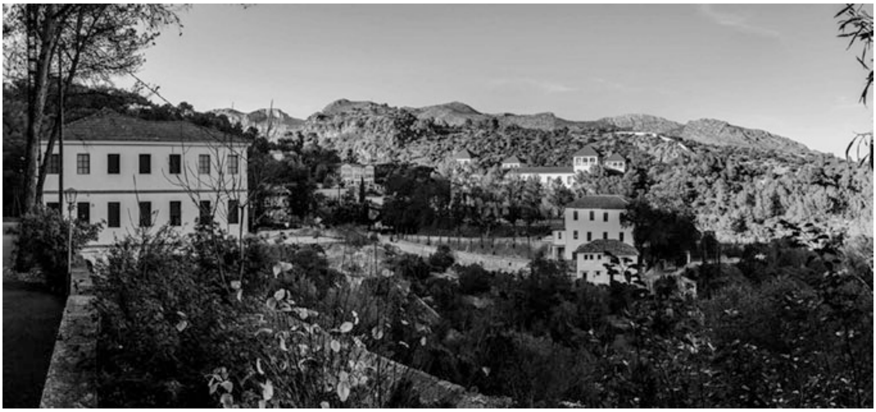

Fig. 2 General overview of the San Francisco de Borja Fontilles Sanatorium with the perimeter wall in the background

aesthetics of medical facilities built at the start of the 19th century using local building techniques. Over the long period that the Sanatorium has existed, a number of different architectural changes have been implemented. On the one hand, it did not comprise a single event but is rather the result of a series of successive events, which led to the gradual occupation of the valley, originating from a nucleus of very simple buildings. Furthermore, with the changes in the medical needs and the constant growth, the complex set the standard for the country, causing a number of physical transformations of the building to make them more suitable for their new functional requirements. Demolition work, rebuilding, extensions and additions, new uses for buildings that were different from their original purpose, led to the fact that there is no single Fontilles Sanatorium, but rather a series of successive sanatoriums whose history is part of a bigger whole.

One particular aspect, which allows us to highlight the aim of the project, is the theatre. As seen today, the building is the result of three successive periods of construction work. The first theatre, designed by Enrique Llopis Soriano was opened in 1915. In the January 1913 edition of Revista Fontilles, there is a reference to a *magnificent chalet with bathrooms, recreation room, operating theatre, doctors' staff room, and other amenities in keeping with the purpose for which it was built* (Bonilla and Bertolín 2010). Later on, in 1922, we see the extension to the Baths, with the addition of a new floor that was to be used as an assembly hall for the Colony. The same style and construction techniques as the original building were used, adding six additional oculi and therefore adding to its length, *with enough room for 18 porcelain baths on the ground floor, recreation and dining room on the main floor and a room for drying the clothes on the upper floor*.

Years later, the purpose of the Baths evolved, due to breakthroughs in healthcare treatment of the disease, so the building underwent a new transformation, with the building of a theatre and cinema to play host to the social and cultural activities that went on at the Medical Colony. This latest addition was opened in 1958, designed

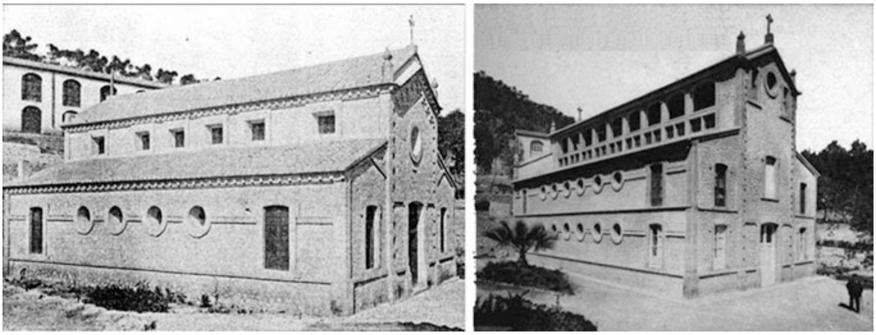

Fig. 3 First and second phases of the theatre: The bath Pavilion (1913) and the extension for its dual purpose of bath house and assembly hall (1922)

by Manuel Peris Vallbona (Bonilla and Bertolín 2010). Currently the building still retains its theatre although admittedly it is used for other purposes, as a mortuary with an autopsy room on the ground floor (Fig. 3).

This chronological sequence, which is shared by many of the other buildings in the complex, is attested to by an abundant supply of documents, both architectural and socio-cultural in nature, which enable us to test the viability of the proposed methodology in order to visually transmit the architectural transformation, by linking the archival documents that refer to the role of the building in the daily lives of the patients during each period of its history, to the photographs of the architecture. In fact, the project is based on a broader concept of the heritage assets of the colony. It might be said that it is impossible to *come to grips* with the complex without knowing the characteristics of the way of life of the patients and the way in which their daily activities shaped both the complex and the immediate environment. Fontilles boasts a vast movable heritage, both from the original residential quarters and from the medical and healthcare materials, which give us a better understanding and allows us to interpret the history of the fight against this disease throughout the 20th century. And lastly, the immense socio-cultural heritage, preserved in the form of photographs, letters, biographies and stories, both written and oral, which give a sense of meaning and enable us to understand the history and the evolution of this architectural enclave. We need to conserve and disseminate all the information as a whole in order to preserve the memory of architectural spaces that are part of one of the most overlooked human dramas of our society, social exclusion due to a disease and the uprooting and ostracism of those afflicted by it (Fig. 4).

This particular heritage, prevalent across the whole of Europe, covers a wide range of disciplines such as Architecture, Medicine, Sociology, History, Psychology, Town Planning, Landscaping, etc., and given its intangible nature, modern Information and Communication Technologies (ICTs) are an essential tool when it comes to the conservation and dissemination thereof. There is great value to the documentary

Fig. 4 Life in Fontilles. Historical photographs

collections and archival materials from these colonies, attested to by the fact that the documentary archive collection of the *St. George's Hospital* in Bergen have been referenced in the *UNESCO's Memory of the World Programme* since 2000.

3 Aims

The project proposes carrying out a global analysis of the heritage site, as well as a general overview of its uses and functions, making it possible to maintain and disseminate the site's rich heritage, as described earlier. An essential aspect of this series of activities is the use of advanced graphical display to enable us to get a comprehensive understanding of the complex by cross-referencing its current condition with the documentary information we have available, In such a way, it is possible to understand not only the form and space that the current sanatorium occupies, but also to display how it has evolved over the decades, as have the lives of the people living there.

The work has been divided into two phases. The first, which is currently underway, sets out to carry out a comprehensive graphic reconstruction of the complex, both in its current state and during its most significant earlier stages, as well as the media available such as photographs, plans and documents that are part of the historical archives of the Sanatorium. In this way, we can display each architectural object, both inside and outside, allowing us to travel from one period to the next from a single perspective, allowing for the active movement through space using game engines such as Unreal Engine 4 (UE4). It would be a question of providing graphic documentation, which, based on digital display techniques, would allow us not only to reconstruct the image, but also to move around the complex, viewing each of the historic stages of this monumental site.

The aim of the second stage is to build a set of fully integrated digital applications with which to recreate a part of European heritage through "immersive experience". To do this, technically advanced interfaces would be required, such as augmented reality and virtual reality, which would allow us to explore the different panoramas through the distinct historical periods, together with gesture recognition techniques to facilitate browsing and navigation through the information. The aim of this project is to explore different cultural contents through interactive experiences in order to achieve a better understanding of the implicit socio-cultural implications of these heritage sites.

4 Proposed Methodology for the Graphic Modelling of the Building

The first phase of the survey consists of state modelling. For the digital reconstruction of the different architectural stages of the colony, three levels of graphical analysis, with complementary methodologies, have been developed: data collection from photogrammetric flights, restitution using a 3D scanner, photogrammetric restitution using Structure From Motion (SFM) procedures and the three-dimensional modelling of the buildings through Reverse Engineering.

To geo-reference the buildings, two aerial fl at different altitudes were taken: firstly a digital photogrammetric fl covering an area of 400 ha, collecting data for the complex in Fontilles, carried out using a light aircraft at an altitude of 698 m, comprised of 76 images with a resolution of 9420 × 14,430 pixels and a focal distance of 100.5 mm using a UltraCam X, S/N UCX-SX-1-50013345 camera with a GSD (Ground Side Distance) resolution of 5 cm (Fig. 5).

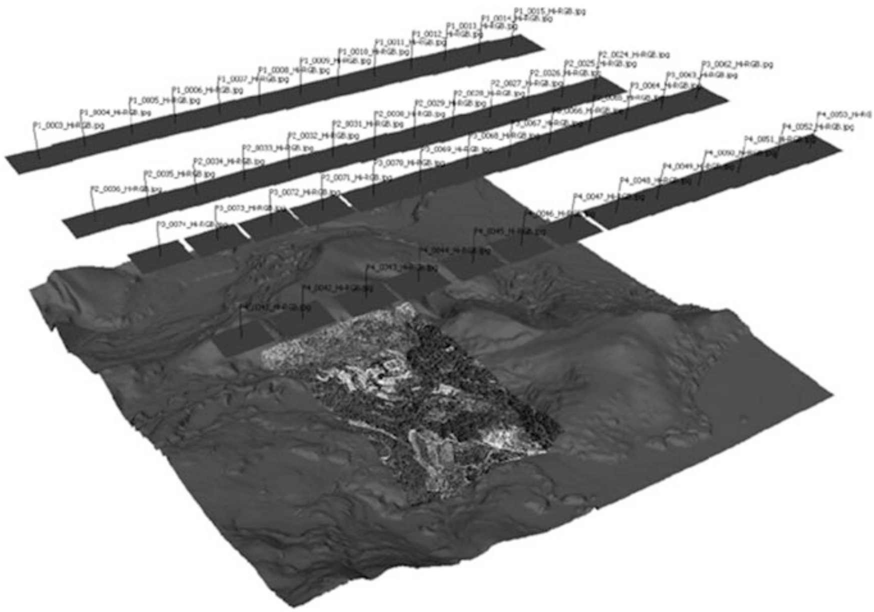

Fig. 5 Result of the photogrammetric flight using a light aircraft

Secondly, and with the participation of the LFA-DAVAP Group from the University of Valladolid, a low-altitude flight using a remote-control drone was carried out, providing escalation data for the complex in Fontilles. Some 460 photographs were taken using an Olympus E-Pm2 camera with a focal length of 24 mm at an altitude 50 m (taken from the highest point), and a GSD (Ground Side Distance) resolution of 1 cm (Fig. 6).

The flights were aligned using 30 coordinates that were recovered from the first flight thanks to the Photomod application and looking for the respective points from the images taken from both flights. The result was a comprehensive definition of the relief lines for the complex as well as the exact positions of the buildings.

For the modelling of the buildings, both the cloud point taken with the laser scanner and the modelling using the mass aerial photography were used.

For the topographic survey, the Leica HDS6100 scanner, manufactured by Leica Geosystems, was used. The point clouds for each measuring station were registered using Cyclone software, designed by the same company. For the scanning of the laboratory pavilion in Fontilles, 86 measuring stations were used to carry out a comprehensive survey of the building over the course of an 8-h day. The density of the scan was "high", which means that at 10 m from the scanner, we get a point density of 6.3 mm × 6.3 mm. In order to speed up the field work, markers were not used in situ. This meant that back at the laboratory, the registration would be carried out manually using the Leica Cyclone Register programme using the "cloud to cloud" method, in other words, identifying the shared points between pairs of point

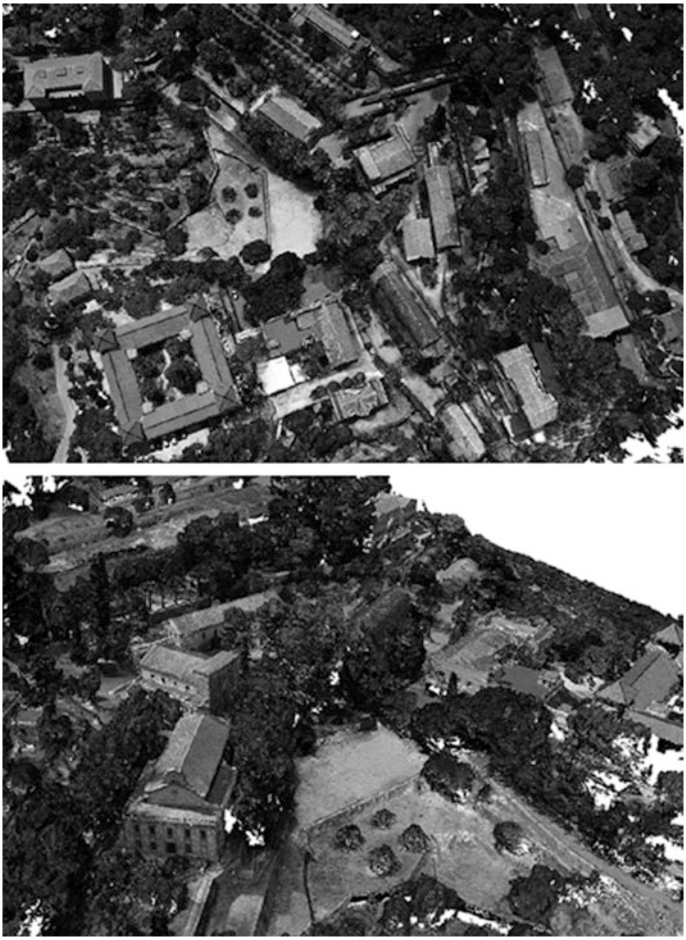

Fig. 6 Result of the escalation flight using a remote-control drone

clouds to carry out registration. Sure enough, the complete point model is obtained by pairing up the clouds obtained from two consecutive measuring stations. Cyclone auto-adds cloud constraints between non-consecutive measuring stations to optimize the aligning of the clouds and reduce general error. As with the photo-based modelling, the information obtained in this way was supplemented by the one carried out using the two flights described earlier.

For the volumetric modelling based on the taking of photographs, an example of the methodology used is the three-dimensional modelling of the different construction phases of the theatre. For the definition of the current volumetrics, a vast series of photographs (2247) were taken and then calculated as a single group, using a variety of different focal distances, relative to the element and the position from which it was taken. Once all the photographs were aligned, we proceeded to calculate the dense point cloud, resulting in a point cloud with a density of 144,591,713 points. The following phase comprised of cleaning up and converting the point cloud into a mesh. The final model had a weight of 288 million polygons, making it unfeasible for later processing, so to facilitate the work, these were divided into 15 parts, decimating it as such to 10 million polygons to be able to comfortably work with the software applications used. The next step was to extract the geometry of the mesh; to do this, reverse engineering was used. Using the "Rapidform XOR3" application, a series of sections were taken from each of the elevations which allowed us to transpose directly onto the mesh, enabling a greater control of the elements contained therein. Lastly, the sections and elevations taken from the mesh were imported into the "Rhinoceros" modelling application used to build 3D models, allowing us to carry out a thorough analysis of the building. Finally, the model was textured, and the orthophotos were extracted for a clearer focus in the CAD application environment. At this point, an analysis was carried out of the *scars* resulting from the numerous interventions carried out on the building, returning the buildings back to their original state (Figs. 7 and 8).

This three-dimensional graphical reconstruction is the basis on which we regress back to the very first Fontilles colony established at the start of the 20th century,

Fig. 7 The laboratory. Original photograph and topographic survey using a laser scanner

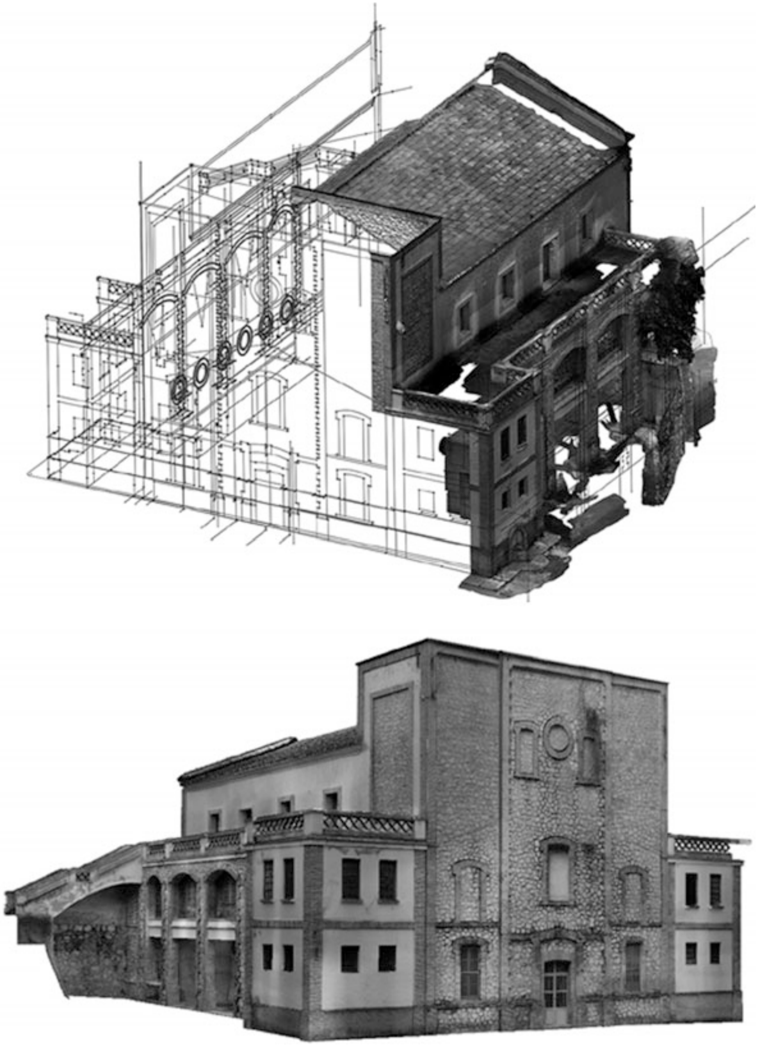

Fig. 8 Three-dimensional modelling of the theatre

passing through all the important stages in the medical colony’s history. To do this, one uses the graphic material from the historic archives of Fontilles, using the restitution of the conical perspective of the images and the present buildings as a reference.

5 Methodological Approach to Visualise the Model

The aim of this second phase of the work is to propose an interactive methodology that allows the user to discover and deal with the current state of the historic images, both exterior and interior, making it possible to have interactive tours based on the graphical reconstruction of the original spaces.

The display method is a multi-step process that requires the use of more than one software package, in addition to the exporting and importing of a variety of different data elements. The game engine is compatible with the main 3D applications such as 3ds Max, Maya, Softimage, Cinema 4D and Blender, which means that there are no real limitations as to the file formats that it supports.

With regard to the vegetation, the effective creation of very detailed and natural environments will be carried out using two different vegetation processing technologies, SolidGrowth and PlantFactory. SolidGrowth is based on random growth technologies that ensure that there are never two plants of the same species and simulate the different colour tones in nature for even greater variety and realism. PlantFactory boasts multiple mesh algorithms, with a system that is able to reproduce very high quality trees, as well as distant vegetation using triangles or *quads*. The plants are generated at the optimum level of details, based on render resolution and viewing distance. This ensures the best quality results with the minimum use of resources.

Illumination is carried out using a photometric sunlight model that employs real-world data, generating the physical simulation of the sun. Atmospheric lighting intensity is carried out using image based lighting (IBL), and High Dynamic Range (HDR) images taken at the Fontilles Sanatorium itself, facilitating photorealistic rendering.

The final aim of the project focuses on the development of multiplatform tools to promote heritage, based on the interaction of the subject with information to achieve a greater understanding of the heritage asset and, consequently, a great implication of the general public in the preservation of architectural heritage. For that reason, the project aims to integrate different types of information sourced from a series of computer applications providing a comprehensive approximation of the architecture and its history: 3D information, such as virtual buildings, models of non-existent buildings and other objects; multimedia information such as photographs, digitized documents and videos; as well as textual information such as letters, medical records, administrative documents, etc. (Fig. 9).

Lastly, the collaboration established with other research groups to put forward a European proposal presented within the framework of the Horizon2020 programme, have opened the possibility of exporting the model to a variety of different interactive tools for mobile platforms, such as smart phones and tablets. The experience of the *Institute of Automation and Industrial Computer Science* (AI2) at the Polytechnic University of Valencia and *The Expertise Centre for Digital Media* (EDM) at Hasselt University, both of which are project partners in the *Digital Model for Disseminating and Highlighting European Heritage: The Leprosy*

Fig. 9 Leap motion + Oculus rift

Heritage Sites, has led to the possibility of implementing augmented virtual reality solutions, as well as creating interactive interfaces, such as *Leap Motion*, geared towards the dissemination to the public at large of the characteristics of the heritage that these sites provide.

6 Conclusions

The recently approved Horizon2020 European programme at last includes heritage research as one of its strategic European aims for the coming years. And it has done so by focusing its attention on the use of digital tools to draw attention to and disseminate and protect the rich cultural heritage legacy of our continent. The scarce implementation of digital strategies to promote a better understanding of the architectural heritage amongst the general public is one of the tasks that are still to be undertaken by organizations and institutions that work to study, assess and disseminate architectural heritage. To achieve this goal, new digital tools have the potential to do much more than be used as the mere graphical reconstruction of architecture. Modern tools allow us to actively interact with heritage information, pushing the envelope of graphics and giving a boost to representation as a method of comprehensive comprehension, making it possible to have immersive virtual tours through tools that are commonly used in videogames and animated film, but also making it possible to fully integrate the documentary information that enables us to better understand architectural assets in greater detail than just the mere spatial representation, transmitting as such the image of what it once was and the ways of life associated with them. It is essential that these types of activities use an interdisciplinary approach, and it is worth noting that this particular project is being carried out by a team comprising architects, historians, doctors and IT specialists whose ultimate aim is to develop a dissemination strategy that can be applied to other places in Europe that are part of the *International Coalition of Historic Sites of Exclusion and Resistance.*

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An Unrealized Project: The Great Cemetery by Giuseppe Damiani Almeyda. From Archive Drawings to Three-Dimensional Reconstruction

Fabrizio Avella

Abstract This study is aimed to the reconstruction and analysis of an unrealized project: the Grand Cemetery by Giuseppe Damiani Almeyda (1834–1911), starting from his original designs, drawn with pencil, ink and watercolor on cardboard. This project won two gold medals, once at the first Exhibition of Fine Arts in Florence, in 1861, and the other at the Exhibition of Fine Arts in Sicily, in 1863. The three-dimensional reconstruction of the model has been used to deduce the criteria of interpretation and perspective views, shaded or rendered, which have been processed trying to visualize the imagined spaces in the original drawings in orthogonal projections.

Keywords Giuseppe Damiani Almeyda · Archive's drawing · 3D reconstruction

This study aims to the reconstruction and analysis of an unrealized project: the Monumental Cemetery for a great capital by Giuseppe Damiani Almeyda (1834–1911), starting from his original drawings.[1]

[1]This study is a deepening of topics covered in the thesis entitled An unrealized project: the Great Cemetery by Giuseppe Damiani Almeyda. Analysis process and three-dimensional reconstruction, made by Giovanni Zinna for the Degree course in LM4-Architecture of Palermo University, supervisor Prof. Arch. Fabrizio Avella.

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Giuseppe Damiani Almeyda, born in Capua in 1834,[2] has a multifaceted education: he studied painting with Giuseppe Mancinelli,[3] architecture at the studio of Enrico Alvino,[4] geometry with Achille Sannia,[5] and the mathematics with Giuseppe Battaglini.[6]

In 1855 He was admitted to the School of Bridges and Roads, in 1855, and he graduated here in 1859, which allows him to enter the Corps of Engineers of Bridges and Roads.

The high school studies permeated Damiani's training of purely artistic and technical aspects: "When he leave the school his characters and artistic personality are already outlined, the duality between the artist ant scientist masterfully resolved".[7] He defends the architect's conception as a figure who embodies both aspects: "the two qualities, artistic and scientific ones, are complementary and indivisible in Architecture […].Therefore, in order to not result incomplete and erroneous, the architectural concept must be consistent in everything and in every part of the artistic and scientific requirements set, so the architect is a artist scientist".[8]

The project of the Monumental Cemetery, thought for a Great Capital not identified, concludes his youthful works, and it has been carried out with much commitment,[9] because for more than a century this theme had become one of test stands for great architects,[10] in the wake of the pulses from France in the second half of the eighteenth century[11]: to design a cemetery become "an important aspect of professional activity of architect, increasingly engaged in high symbolic and representative value designs".[12]

The Cemetery drawings are preserved in the Archives Giuseppe Damiani Almeyda of Palermo.[13] There are several versions of the project, identifying four phases. This study takes into account the latest version, that one presented at the

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[2]For the biography of Giuseppe Damiani Almeyda see BARBERA, Paola. 2008. *Giuseppe Damiani Almeyda, artista architetto ingegnere,* Palermo and Damiani (2001). *I casi della mia vita*, Palermo.

[3]Giuseppe Mancinelli (Naples, 1813–Palazzo di Castrocielo, 1875), neapolitan painter trained at the Royal Institute of Fine Arts in Naples.

[4]Enrico Alvino (Milan, 1809–Rome, 1872), architect from Milan, active in Naples during of the Ferdinand II of Bourbon kingdom.

[5]Achille Sannia (Campobasso, 1822–Naples, 1892), mathematician, author of *Lezioni di Geometria Proiettiva dettate nella Regia Università di Napoli dal prof. Achille Sannia*, Naples 1891.

[6]Giuseppe Battaglini (Naples, 1826–Naples, 1894), mathematician and geometer.

[7]Barbera (2008, 34–35).

[8]Damiani Almeyda, Giuseppe. *Scuola italiana di Architettura Civile*, unpublished, *Proemio*.

[9]This theme is fully inserted even in architectural treatises. See Milizia (1785).

[10]See Valeriani (1987).

[11]Latini (1994).

[12]Albisinni (1994, 33).

[13]Provisional location: drawer D6.

First National Exhibition of Fine Arts in Florence in 1861 and at the Exhibition of Fine Arts in Sicily, in 1863, winning the gold medal in both cases.

Of this version there are three plants, two hypotheses for the main façade, a portion of one side elevation, the complete side elevation and a longitudinal section. The plant, the side elevation and the longitudinal section really sent by Damiani to participate in competitions have been used for the virtual reconstruction.

The original drawings are made on cardboard with pencil, ink and watercolor. The plant measures 99.43 cm × 66.58 cm. The longitudinal section, of imposing size, measures 65 cm × 351.3 cm, and it's made of 4 sheets pushed together, the first of which is long 60 cm and the other three about 97 cm. The main façade measures 65.75 cm × 241.25 cm, and it's made through combination of three boards long about 71.6, 97.4, 72.3 cm (Fig. 1).

None of the drawings presents written, autograph inscriptions or metric scale indication. So, to derive their metric scale, it was considered one of not presented boards where there's an autograph note with written "1:800" and that the proportions between the size of the plant and those of the elevations it is of 1:4. Therefore, the plant metric scale should be 1:800 and 1:200 that one of elevations. The unit of measure is probably the Sicilian cane.[14] The use of a not metric measuring system with centesimal scale factors may seem strange, but it has been found in other Damiani's works of the same years (Fig. 2).

The hypothesis of this measuring system is confirmed by the modular study and some annotations on an autograph document.[15] The composition, that refers to Durand's typological studies, which were carefully studied by Damiani, is built with modules based on Sicilian cane. Just some examples: the intercolumn in the central cloister is two canes, the center distances of the church, facing the chapels are one rope, equal to 16 Sicilian canes and the distance between the longitudinal axis of symmetry and its parallel is 5 strings, equal to 80 canes.

The compositional structure is built with a very simple geometry based on the square, dominated by three longitudinal and three transverse symmetry axes.

The building has a strong religious character, clearly marked by Damiani himself: "Here then the character to impress in any Christian grave: Peace and Hope. A religion of the whole spirit must jealously conceal the horror of the breakup of the body, and to show the ideas of forgiveness and Eternal Life […]".[16]

The composition is spread over several levels with large open spaces surrounded by colonnades. The entrance is marked by an carriageable access leading to the

[14]The Sicilian metric system, based on canes, palms and ounces, was legally used until 1866 but it has been used afterwards for a long time. The sicilian cane, 2065 m, was divided into 8 palms (25.812 cm), divided into 12 oz (2.151 cm).

[15]This memory, written by himself, describes the project, and is, probably, a draft of the final report. In this document Damiani describes in palms the dimensions of some rooms (pp). *Memoria illustrativa del progetto accademico per una città capitale*, Archive Giuseppe Damiani Almeyda, temporary location: *Progetti accademici*, 1B7. The document was signaled by the Archivist Antonia D'Antoni.

[16]*Memoria illustrativa del progetto accademico per una città capitale*, cit.

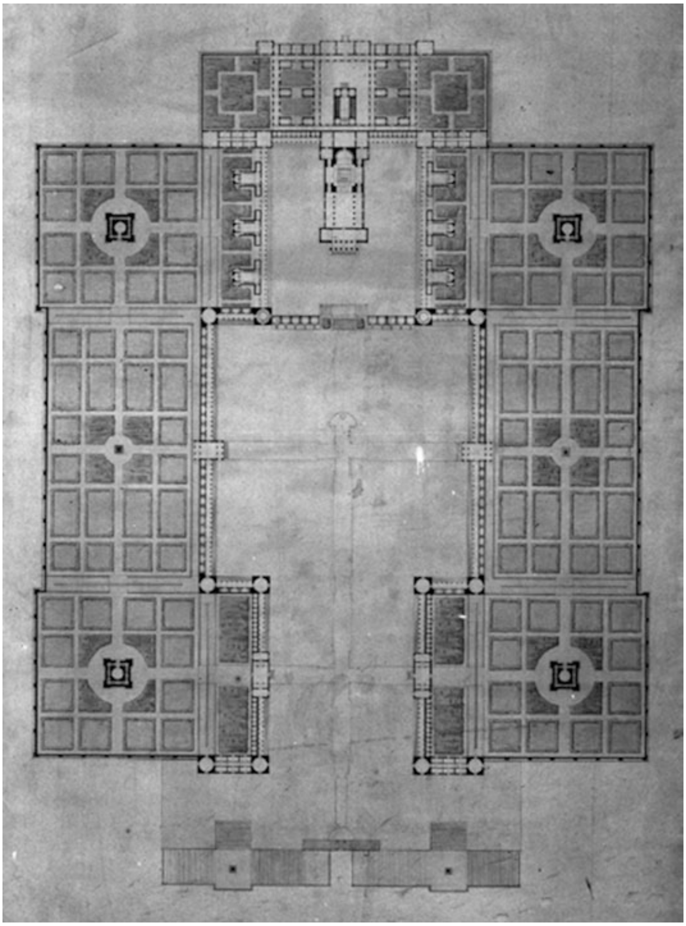

Fig. 1 Plan view (Giuseppe Damiani Almeyda Archive in Palermo)

underground tunnels (A) and two imposing staircases (B) leading to the first "rectangular atrium […] completely open on two sides and limited by two small module porches on the others"[17] (C1). The access to the atrium is between two small "workshops with four circular rooms"[18] designed to "the custodians, administration and archive".[19] Among the colonnades (E) there're two rooms (F) designed one for "notable people, the other one for experiments".[20] Behind these buildings there are "two gardens of shady trees, destined to make best the

[17] *Ivi*.
[18] *Ivi*.
[19] *Ivi*.
[20] *Ivi*.

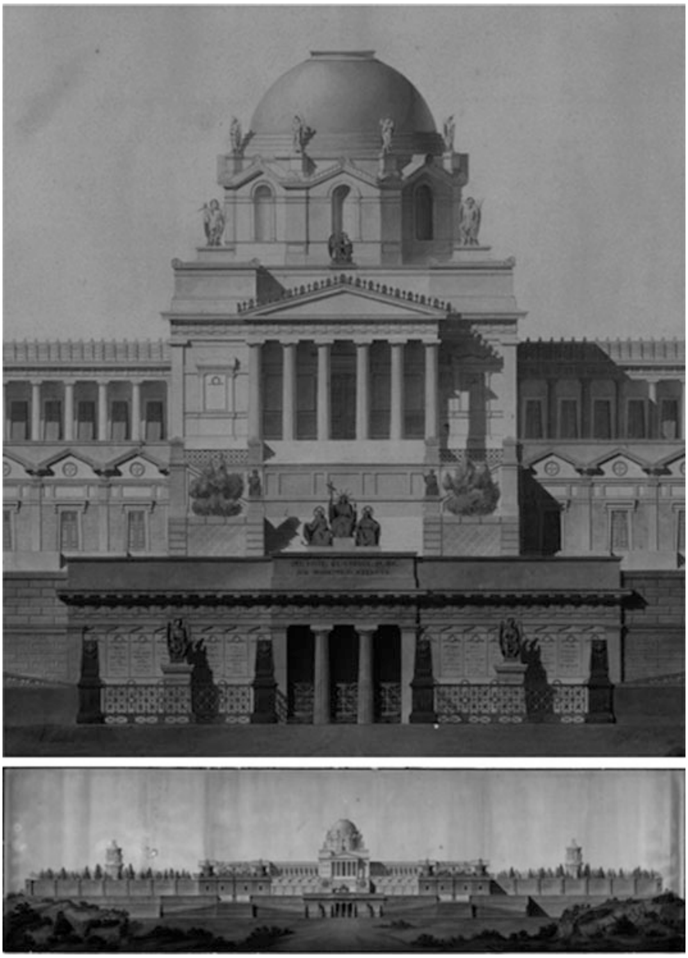

Fig. 2 Main front (Giuseppe Damiani Almeyda Archive in Palermo)

area”[21] (G); they gives access to two perfectly square gardens (H), “intended to the interment of the bodies of dead people who paid the land for their burial”.[22]

From the large central gate one can switch “to an atrium on the level of the first very large and perfectly square […] surrounded by the funerary family chapels”[23] (I), distributed around long porches. Two pronaoi are positioned at the center of them (L) leading to the ramps giving access to “two vast square gardens […]

[21]*Ivi*.

[22]*Ivi*.

[23]*Ivi*.

intended to the burial of the poor people"[24] (M). The main courtyard (C2) is concluded from a perspective backdrop defined by "ten graves largest and richest of the others, reserved to the most conspicuous families of the country"[25] (N) and it's marked on the corners by eight "cenotaphs of famous men",[26] with circular plant inscribed in a square.

The highest part of the composition has a columned hall (C3) that serves as a forecourt to the "basilica located in the middle"[27] (P), flanked by six chapels intended for "pious congregations of brothers"[28] (Q), whose relatives are buried in two small square fields (R), facing the an area which "six burials subjected to the six congregations which serve for preserving the ashes of the brothers"[29] (S). The burial of the congregants is expected in the large square fields below (T). The rooms of "a small convent capable of sixteen brothers who is not lacking a small oratory, a library and gardens"[30] (U) are set against rear wall on the boundary.

All gardens for inhumation are connected by carriageable ramps (V) at the entrance by an underground system of passages by a cross-shaped system of underground passages. At the center of each of the large square fields "stands a mausoleum where the ashes of illustrious men in arts in sciences in literature and in weaponry could be disposed"[31] (Z).

The arrangement is a "symbolic representation in reduced format of society"[32]: the death join everyone inside the same fance but the layout reveals social differences between the most prestigious families, noble or ecclesiastical, and the poorest people, buried in fields at lower levels or in underground ossuaries (Fig. 3).

The monumentality of the project is underlined by the symbolism of the ascending path, culminating with the church and the architectural language. It was used the Doric order, deemed suitable to the design theme, according with the Vitruvian decor: "The architecture of the project is Doric Greek, like the one that brings together simplicity and severe character […]".[33]

Damiani was a careful scholar of classical architecture: later he wrote a great work for educational purposes, the *Istituzioni ornamentali sull'antico e sul vero.*[34] His classicism is expressed in his way of drawing, for the representation methods chosen and the technique used. Damiani has had a rigorous education about the drawing: he knew very well the representation methods and drawing techniques,

[24]*Ivi*.
[25]*Ivi*.
[26]*Ivi*.
[27]*Ivi*.
[28]*Ivi*.
[29]*Ivi.*
[30]*Ivi.*
[31]*Ivi.*
[32]Ariés (1980, 591).
[33]*Memoria illustrativa del progetto accademico per una città capitale*, cit.
[34]Damiani Almeyda (1890).

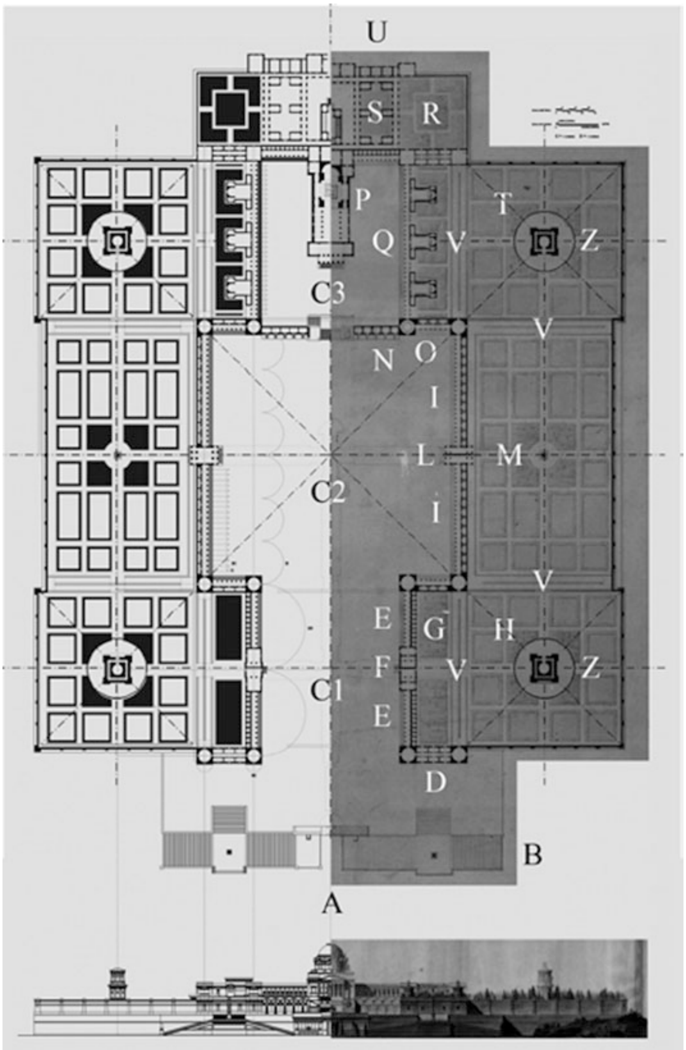

Fig. 3 Plan view: geometric and modular scheme, environments layout (vector drawing by Giovani Zinna)

which won him the professorship in the new Technical Institute in Palermo, in 1864, and the drawing professorship at the Royal Palermo University, in 1879. He published also another book for educational purposes,[35] *l'Applicazione della*

[35]About his teaching activity see Pirajno et al. (2008).

geometria elementare allo studio del disegno,[36] where issues related to orthogonal and perspective projections were addressed. Regarding his skill in using the technique, it was certainly shaped by his pictorial training.

The project under examination is drawn in orthogonal triad: plan, elevation and section, as most of his architectural production. The orthogonal projection is a perfectly suitable method of controlling the proportional system that underlies a building both in plan and elevation. The plan allows a strict control of the modular composition of the spaces and the elevation. The drawing in elevation is a perfect control tool. The plan allows a rigorous control of the modular composition of spaces, while the elevation design is a perfect control tool of the modular system of architectural order. The expressive choice made by Damiani of using the orthogonal triad must be understood as being closely linked to his classicism. As well as in his youthful projects, it was the same in many of his more mature projects and didactic works.

However, the methodological choice of using the orthogonal triad involves some pitfalls. The lack of three-dimensional control can be the cause of design incongruities. The most significant concerns some differences between plan and section. The two wings of the first colonnade have 11 columns in plan and 10 in section, the two wings of the colonnade of the large central space have 23 columns in plan which are the filter for 12 funeral chapels, while, there're 20 columns in the cross section that filter the inputs of 10 funeral chapels.

Perhaps in this case, besides the fact that the lack of the isometric elaborates and perspective views would reveal the contradiction, it was a design afterthought. It is therefore likely that the section was drafted at a later time than the plan and Damiani has felt the need to rectify the rhythm and the composition during its drafting.

As it usually happens in conjectural reconstructions[37] the data must be interpreted trying to give them the right meaning.[38] To make the virtual model has been taken as a reference the indication of section because it was considered posthumous respect to the plant and more controlled thanks to the greater level of detail resulting from the scale of representation. Furthermore, it is perfectly congruent with the front view, it is in the same scale and it presents a decisive value for a project to be submitted to a jury (Fig. 4).

The plant of the digital model was obtained with the vectorizazion of the original drawing and corrected later according to information provided in the section. For this reason, the vector plant shows some differences compared to the one designed by Damiani.

[36]The complete title is: *Applicazione della geometria elementare allo studio del disegno nelle ricerche delle proiezioni, delle ombre e della prospettiva colle nozioni sul chiaroscuro, sul colore e sulla prospettiva aerea*, published in Palermo in 1877 and, afterwards, in 1902.

[37]On the methodological implications of conjectural reconstructions, it is recommended to read the essays contained in Vesco (2014) e Antista and Cannella (2015).

[38]About the concept of hermeneutics see De Rubertis (2002 [1998]). *Il disegno dell'architettura*, Rome.

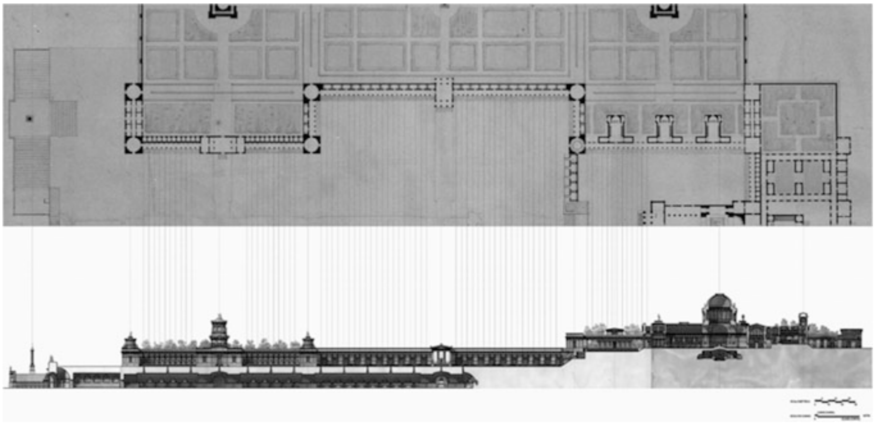

Fig. 4 Design incongruities found by comparing plan and section (vector drawing by Giovani Zinna)

Once the plant has been established the three-dimensional model was developed; the representation has involved some considerations,[39] for example, concerning the use of color in Damiani's drawings. The architect for him isn't only a creator of forms or an architectural order composer, but he must also define the surfaces: "The Architect is a painter and sculptor of buildings; the difference is that they stop to the only outward semblance of an organism copied from nature, while he invents every time something completely new and he must represent it with elegance and clarity from the most intimate structures to the outer surface".[40]

There is no doubt that his training as a painter, had by Mancinelli in the teenage years, has left indelible marks in his way of representing and thinking about architecture. For Damiani *dispositio*, *proportio*, *decor* are not enough. The incessant use of the color suggests that architecture is also made of materials: architecture, without materic definition, becomes meaningless. It can not be conceived neither represented: the color therefore becomes an essential instrument of expression.

The methods and techniques of representation are also symbolic choices, the implications of which relate to the value given to the drawing, ranging from abstract registers to those decidedly mimetic.[41]

[39]See Migliari (2004).

[40]Damiani Almeyda, Giuseppe. *Scuola italiana di Architettura Civile*, unpublished, *Proemio.*

[41]Please refer to the concepts of *póiesis*, *mímesis*, *tékhne themes,* deepened by Vittorio Ugo in UGO (2002 [1994]).

To interpret this project its main features have been identified: classicism, monumentality and attention to the material definition.[42]

For correctly representing the classicism some precise choice were made. First of all the perspective vertical plane. In the absence of a particular development in height, the perspective vertical plane, typical of the "Renaissance" style, seemed like a choice consistent with the representation of spaces.

Another choice to emphasize the neoclassicism of the building was to produce some views in gray tones, recalling the beautiful Karl Friedrich Schinkel's drawings, in which the absence of color could render the idea of volumes and architectural orders.[43]

In these perspectives the register is abstract, the atmosphere is rarefied, quiet as it should be in a cemetery space.

The neoclassicism of Damiani, however, is also son of a cultural debate on polychrome architecture, which at that time involves Sicily.[44] His love for frescoes, wall paintings, decorations and bas-reliefs, as well as being the result of its formation, as already mentioned, it's also perfectly in line with the architectural theories of the time. It would be a mistake not to take it into account. Here, then, why some perspectives have been rendered, especially where the decorative component was considered of great importance. This is not a concession to photorealism, but it's a fitting tribute to an architect and painter, able to imagine the rigorous spaces cleverly decorated (Figs 5, 6 and 7).[45]

In the case of the church, for example, the high level of detail of the original drawings made it possible to transform parts of them into textures for the wall paintings, or to identify the gold finish of some moldings. It was also possible to reproduce the material definition hypothesized to emphasize the Doric order, or to characterize the marble columns of the tambour. The original section is full of useful information and it would be unfair to neglect (Figs. 8 and 9).

To try to reproduce the space of the church they were also produced anaglyphic[46] stereoscopic views, in order to capture the perceptual simulation of the space, thing only conceivable in the beautiful drawings by Damiani.

The cemetery project concludes his youthful phase, rich in projects free to express his architectural theory as devoid of compromises imposed by the accomplishment. The theme, very dear to Damiani, will be resumed in his monumental work on architectonic typologies, unfortunately not yet published, the

[42]The aspects of the building considered for the virtual reconstruction are crucial for the representation of the digital model. Look, about this, the results of the studies collected in Marsiglia (2013).

[43]The issue of the congruence between the representation techniques and the object of virtual reconstruction has been addressed in Maggio (2011). *Elien Gray. Interpretazioni grafiche.* Milan.

[44]See Gallo (1997).

[45]An excellent anthology of renders ranging from abstract techniques to photorealistic ones can be found in Schillaci (2009).

[46]The views were not been annexed because printing in gray tones of the anaglyphic views would not allow visibility.

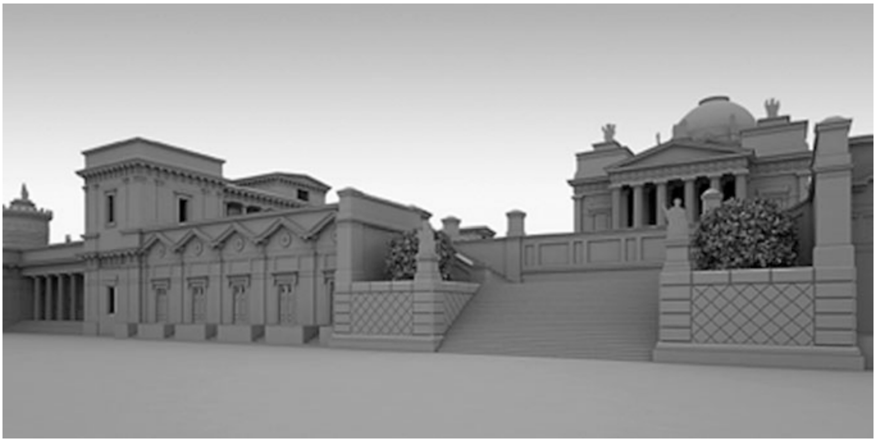

Fig. 5 Perspective view (modeling and rendering by Giovanni Zinna)

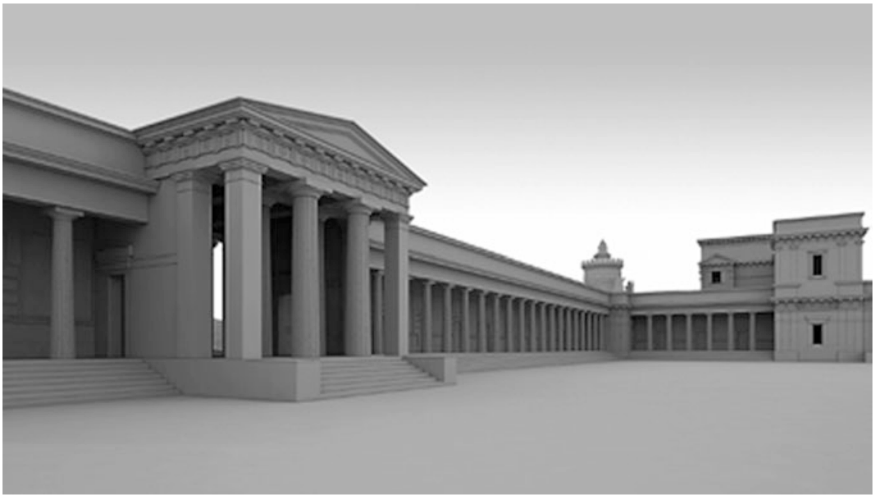

Fig. 6 Perspective view (modeling and rendering by Giovanni Zinna)

Scuola italiana di Architettura civile[47] which contains 60 boards, describes the main types of architecture. The tables by n. 50 to n. 53 are dedicated to a *Cemetery for a first-order town*. The plan is different, although there are similarities such as

[47]Initially entitled *Istituzioni Architettoniche*, it is conceived as part of a two-volume work. The other volume, the *Istituzioni Ornamentali*, was published in 1890: Damiani Almeyda (1890). *Istituzioni ornamentali sull'antico e sul vero*, Turin-Palermo.

Fig. 7 Perspective view and cross section (modeling and rendering by Giovanni Zinna)

Fig. 8 Perspective view of the church interior (modeling and rendering by Giovanni Zinna)

the hierarchically dominant presence of the church, located at the peak of an upward path divide in overlapping plans (Fig. 10).

The similarities are more pronounced in the elevations, where it's possible to recognize many elements derived from the youthful project. The reconstruction of three-dimensional model of this second version has allowed to catch the similarity of some compositional themes.

Fig. 9 Perspective section of the church (modeling and rendering by Giovanni Zinna)

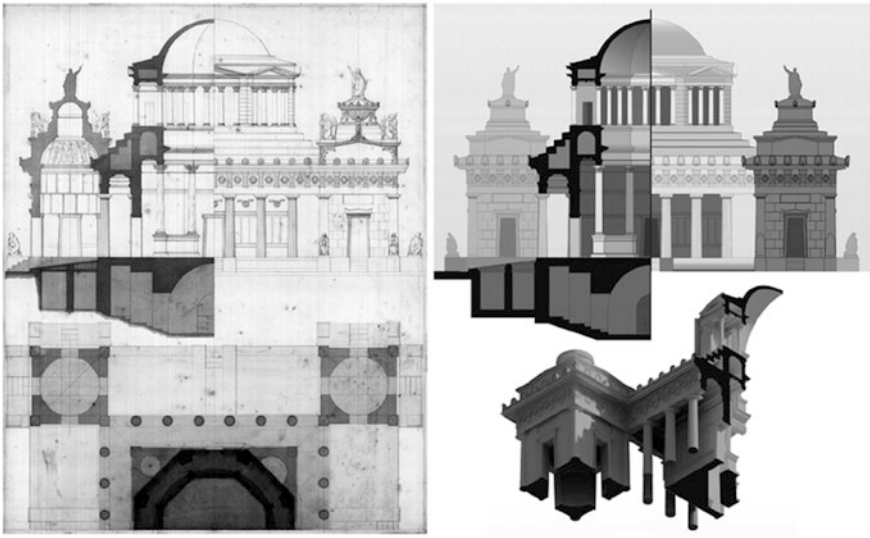

Fig. 10 Board n. 53 of the *Scuola italiana di Architettura civile* (Archive Giuseppe Damiani Almeyda in Palermo) and the digital model views (modeling and rendering by Federica Cerniglia and Pietro Dario Fiore)

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Drawing: Method and Conclusion in Architectural Research

Ángel Martínez Díaz and María José Muñoz de Pablo

Abstract This paper discusses the role of Drawing in Architectural Research and attempts to show it as a valuable instrument. First we will fix the concept of Research referred to the Discipline and consider the reasons for using Drawing as a specific language of Architecture and its consequent implications. At this point we will take a look at the scope of researches where the use of Drawing is a matter of importance. History, Reconstitution, Determination, Composition, normative, ideological or constructive proposition etc. are all involved with more or less intensity, depending on the aims of the research. From the vision of this scene, it is possible to deduce that in any research in which the architectural form is involved, the use of Drawing is not only advisable, but indispensable, as the main element of methodological systematization and as a formal expression of the conclusions.

Keywords Drawing · Method · Architectural form

The almost indissoluble link that binds Drawing to Architecture and the instrumental nature of the first relative to the second, make very difficult to separate specific fields for each of these disciplines. This statement may be categorical in excess, but it is however especially true when our goal is to delve into the knowledge of Architecture. In this *effect to figure out, with an exercise of intellectual nature, the qualities and relations of things*,[1] Drawing has a central role. The powerful analogy that we can set between Drawing and Architecture, fully operational, makes both resonate in unison. Their natures agree essentially because

[1]First meaning of the term knowing (*conocer*) in the dictionary of the Royal Spanish Academy http://lema.rae.es/drae/?val=investigaci%C3%B3n. Accessed October 1, 2015.

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both involve the material and the intellectual in a single reality. Their qualities, despite their distance and their different dimensional nature, link in an almost deterministic way, probably thanks to the intermediation of light. Lines and marks on a surface, intensity values and contrast, colors and grain, shape and composition… are presented as the evident analogy of the form and qualities of architectural spaces. Finally, the relationships we search when we analyze what might be called order or structure of things, are presented equivalently in Drawing and Architecture (or rather, in the drawings and in the architectures). Both are the result of the integration of parts or roughly identifiable or autonomous units. And they are also the result of the links established between those parts.

1 Language

Back to the statement that defines the act of knowing, in addition to specifying the object of the searching, we are warned that the research must be *carried out by the exercise of intellectual faculties*. This assertion involves reason. It must govern the process, so that, by eliminating (or at least trying to eliminate) the subjective constraints, we can ensure the universality of the results of the inquiry and, ultimately, attain knowledge. Knowledge must be valid for everyone. At this point, the intervention of language is essential. It is not only our fundamental instrument to express what we think or feel. It is also an indispensable vehicle for the formation of thought itself. One that, beyond being purely intuitive, involves the exercise of the intellectual faculties. The names of things and the relationship between them are very important. These names are needed for taking them into account as a separate reality, and their semantic fields are crucial for reasoning.

Verbal language is the most powerful language available to us. We are using it right now. It's the one that allows us to think, understand and internalize what we are discussing. It's the vehicle of communication between this writer and his reader. But obviously, it's not the only one. Thinking Architecture requires a language capable of identifying architectural concepts, giving name to realities and relationships in order to operate with them by substitution. That language, as we all know, is not a purely verbal one, it is insufficient. It happens the same in other disciplines. Perhaps we may find the clearest example in the hard sciences. They require another language, in this case the mathematician, without which their utterances, inferences and conclusions can not be processed or expressed. The specific language of Architecture may be mixed or with multiple faces, so perhaps it can not be unlinked entirely from the verbal one, or it is not so systematic as it was expected to be in their joints (for sure). We can state quite categorically that it must be a graphic language, or in other words, Drawing is that language. With its shortcomings and ambiguities, with its limitations and gaps, but with all the advantages that allows its extraordinary essential convergence with the architecture itself.

At this point, we could agree on that for knowing Architecture (or the architectures) we need, almost inescapably, Drawing (or the drawings). With it (or them) we can find out, using Reason, the nature, qualities or relationships of the Architecture (or architectures). We will need a greater or lesser extent of this use depending on how we will approach the object of study, looking at its own essence, or at its contextual periphery.

2 Research

Given the controversial nature of our discipline, research in Architecture is an activity that has had different approaches. It has been stated, perhaps not without reason, that making architecture is almost the same activity. Making an architectural project and building it, is an act in which a process of inquiry occurs. There is a search for solutions to problems where Reason plays a key role. But we must admit that Reason is not the only agent involved, it is always accompanied or monitored by some other agent. That agent could have many names, but it could be identified as something like intuition or, at least, as the result more or less apparent of the subjective. Further, the process of making architecture leads to a certain, specific, material result, perhaps too detached from the inherent universality of knowledge or the desired increase in it. In any case, without wishing to generate controversy, we could understand here the concept of research in its strong sense. Back to our supposed source of authority,[2] we would define it as *performing intellectual and experimental activities systematically in order to increase knowledge on a particular subject*. If we applied this statement to Architecture, we should accept the need of existence of an experimental system applied to intellectual (mental-reasonable) and experimental (practical-material) activities related to knowledge. As we suspected, it seems that Drawing, as a specific language, a thought-shaper and a radically operational instrument, would be called here to play an important role in both types of activities. And that seems to have occurred on numerous occasions.

Looking at one end of the spectrum, Drawing may have been mere illustration in a research, an almost dispensable companion. Considerations on styles, attitudes, ideologies, theories, rules, movements etc. have been possible without images or using them just to clarify what has been stated verbally. That ancillary use of the image becomes more difficult to maintain when the matter is inquiring about the spatial or the material reality of Architecture. Something similar happens in those disciplines in which the spatial location is a prerequisite for the identification of elements and their relationships, from Anatomy to Cosmology.

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[2]Second meaning of the term researching (*investigar*) in the Dictionary of the Royal Spanish Academy http://lema.rae.es/drae/?val=investigaci%C3%B3n. Accessed October 1, 2015.

3 History

To check the need of this presence of images, we can start with an example in which, a priori, it would seem that verbal language would be the main and essential means of expression: the historical essay of the Architecture. Here, events and situations, causes of change and examples can be explained by words. However, many histories of Architecture failed in their aims due to lack of images. Without them we have not been able to understand, in the best case, what the author was trying to convey. And in many of these works, even where the text was accompanied profusely from photographs, we have sought in vain specific drawings of the discipline, with the uneasy feeling that we slid just over the epidermis of architectural facts. But besides this need of the image (or better, the specific drawing of the discipline) to *illustrate* the transmission of knowledge (of the conclusions of the research), we could imagine another path that would lead us to something beyond. How much have we learned and enjoyed with some other histories of the Architecture where Drawing, not only accompanied, but was a inseparable part of the narration itself, from Viollet-le-Duc[3] (1854–1868) (Fig. 1) or Choisy[4] (1899) (Fig. 2) to Schubert[5] (1924) and Fletcher (1896) (Fig. 3). Perhaps the latter is a good example of how Drawing begins to take on a role that goes beyond the communicative act, becoming an essential part of the research methodology. There could not have been made a work like this without images, not just in its final execution, but in regard to what we are told, it is almost impossible to be conceived without drawing. We could even say that in cases like this, the text (verbal) translates into words what has been investigated first by the drawing itself. Now word and drawing invert their provided roles. The extreme case would be a research produced without words (or almost without words) and configured, narrated and explained using a graphic discourse. Good examples are not lacking, even in the field of History. Let us remember Sacriste (1969) (Fig. 4), and its parallel of building plants of all ages. It seems undeniable that we can learn with it more about the evolution of Architecture than with many other documented verbal speeches.

Without leaving the field of Architecture and its past and focusing on the study of a particular event, place or period, we could recognize instances where Drawing is the key. The historical Reconstitution, the searching for the form of a vanished past, is an evident case. The Lanciani's Rome (1893, 1901) (Fig. 5). Does it need words? Is it possible to be conceived without drawing? Are not these drawings

[3]In this case perhaps his most representative work, as its title indicates, rather than a history is a dictionary.

[4]There are many works that can be referred of Choisy. As concerns here, besides his *Histoire de l'architecture* included in the references, we could remember his *L'art de bâtir chez les Romains* and *L'art de bâtir chez les Byzantins.*

[5]We refer to his *Historia del Barroco en España.*

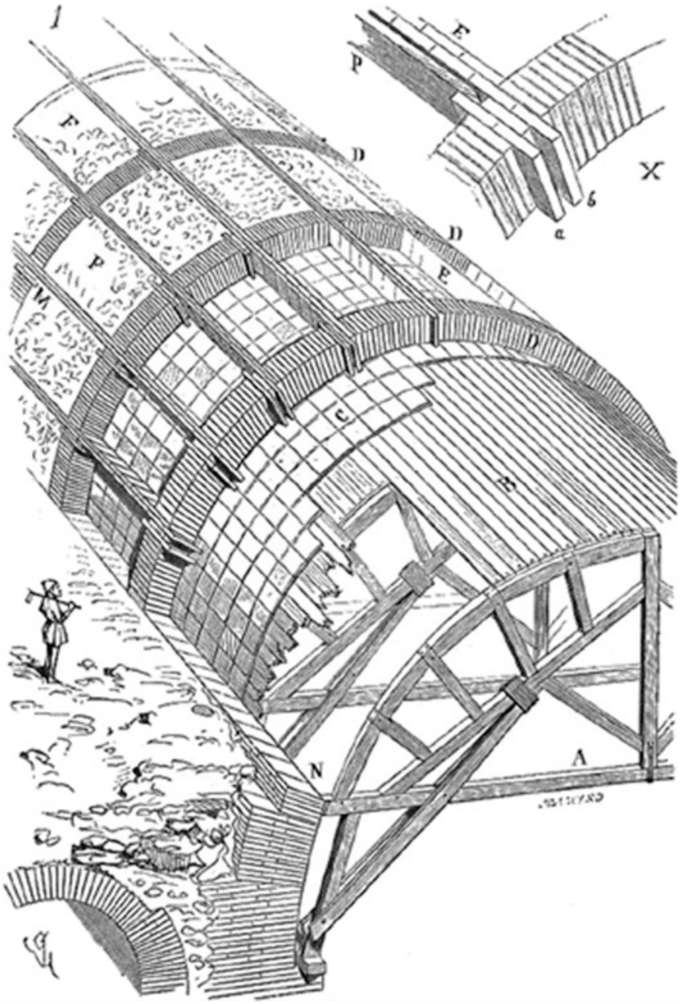

Fig. 1 Viollet-le-Duc. 1854–1868

expressing the very conclusion of the inquiry? Do not they represent a true knowledge? These are questions with obvious answers. They place Drawing in an incontestable methodological and conclusive status. And they grant it a recognized and universal value.

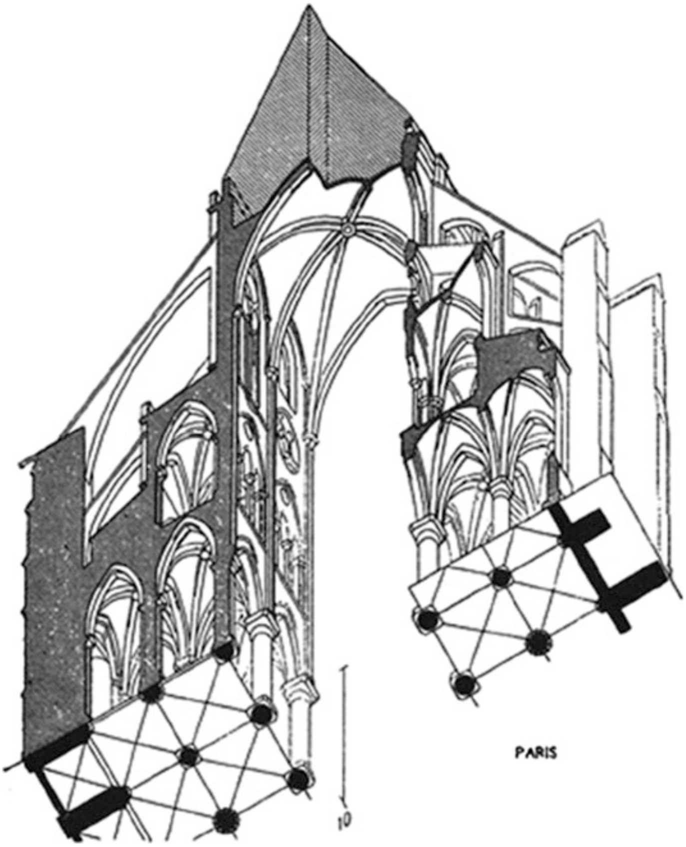

Fig. 2 Auguste Choisy. 1899

4 The Discipline

Reviewing other areas in which Drawing has been an irreplaceable instrument of search and an expression of results, it is not necessary remember that the research that shaped and systematized the discipline had to be done with drawing. They all drew, from the brave Renaissance masters, seekers of truth in the perspective, to Desargues or Monge. But beyond this primary recognition, and almost contemporary to the invention of perspective, we find the origin of another line of research that has had to use Drawing as an irreplaceable methodological resource. When the first Renaissance architects inquired into the Roman ruins as a source of objective architectonical knowledge, they did it drawing, re-building what was left of them with strokes on paper. Only capturing graphically—and unequivocally—the model, they could get to redo the great architecture still testified by its remains. Some of these drawings still retain the power of conviction and evidence that its authors

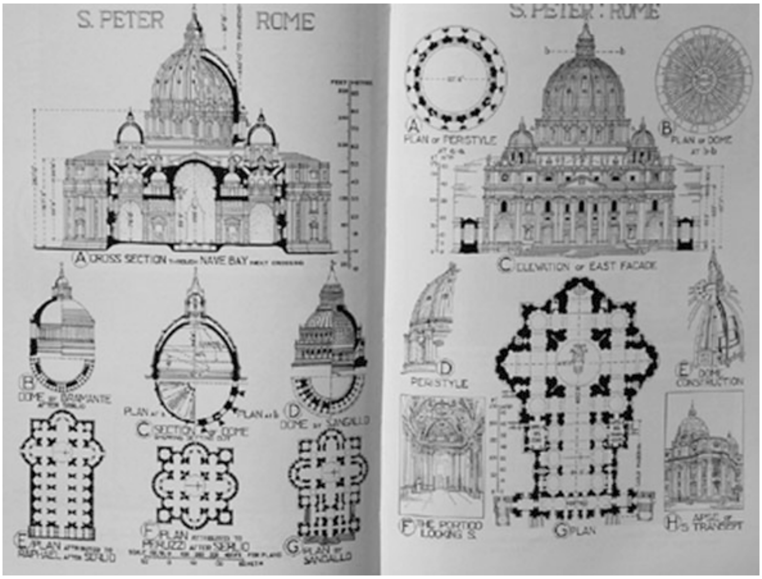

Fig. 3 Fletcher. 1896

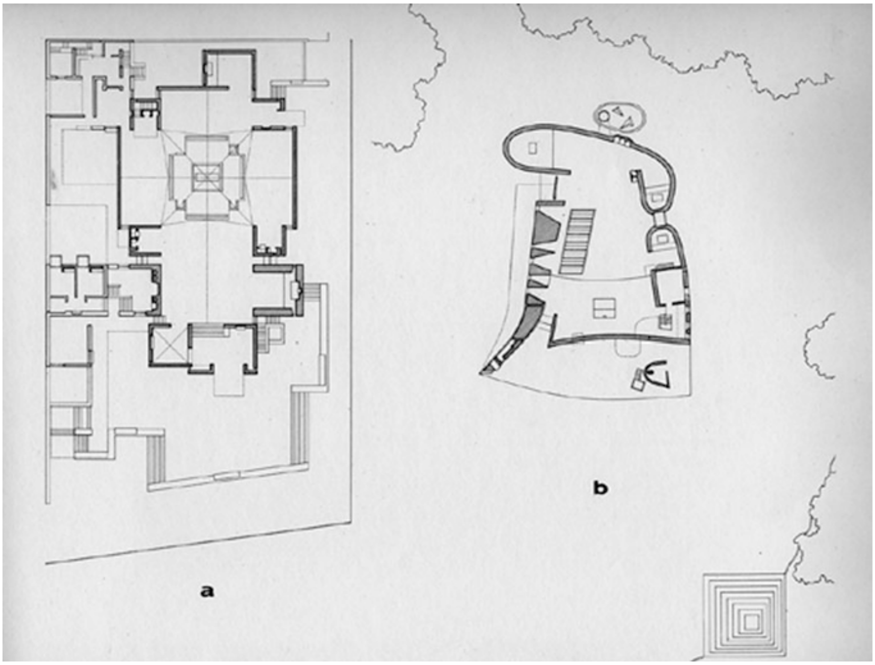

Fig. 4 Sacriste. 1969

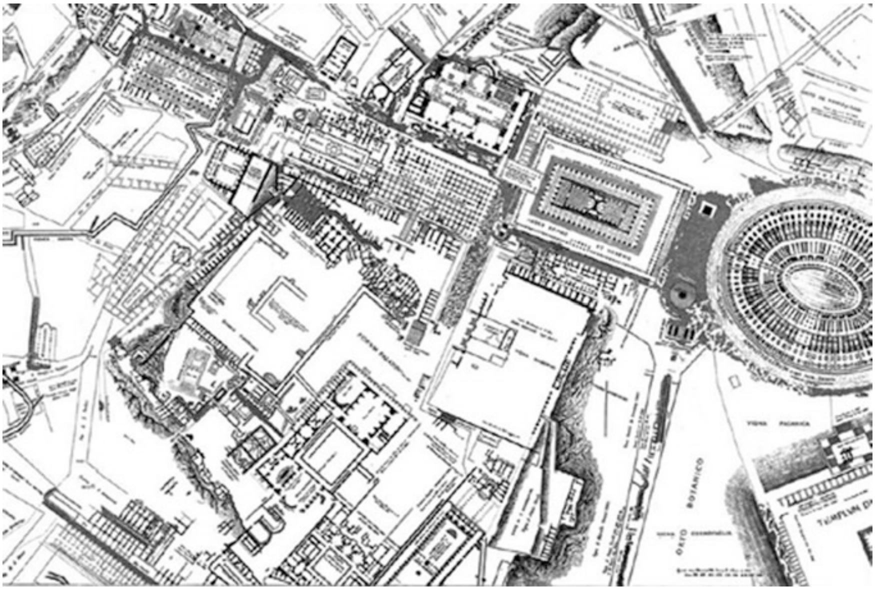

Fig. 5 Lanciani (1893)

intended (for instance, remember the fascinating production of Antonio da Sangallo the Younger). That sap fed for a long time a research activity (increase in objective knowledge) of undeniable value as a basis for other proposals. It is filled with some exciting episodes, as those derived from the normative concern about classical orders (from the *Parallèle* of Freart de chambray (1650) (Fig. 6) to the *Nouveau Parallèle* of Normand, 1819[6]), the *envoys* associated with academies or the brave campaigns related to Greek and Egyptian ruins in the nineteenth century. Surveying, as we understand it today, as an objective description of architecture, is heir to this tradition. It should be considered as a research activity, more or less ambitious, but with all the implications associated to that category. And this research can be neither made nor concluded without drawing, whatever instrument we use (Fig. 7).

[6]The exceptional work of Charles Pierre Joseph Normand takes the fruitful title of *Parallèle*, so beloved by the French architectural historiography.

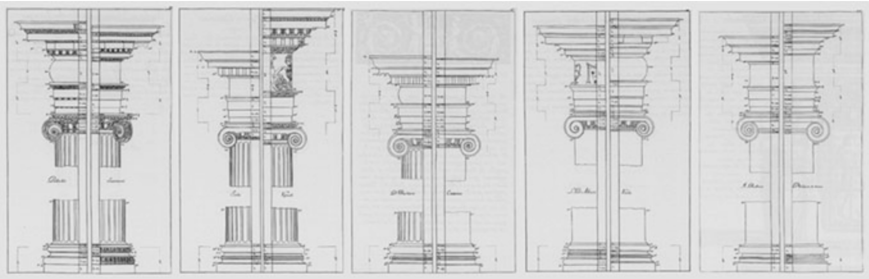

Fig. 6 Frèart de Chambrais (1650)

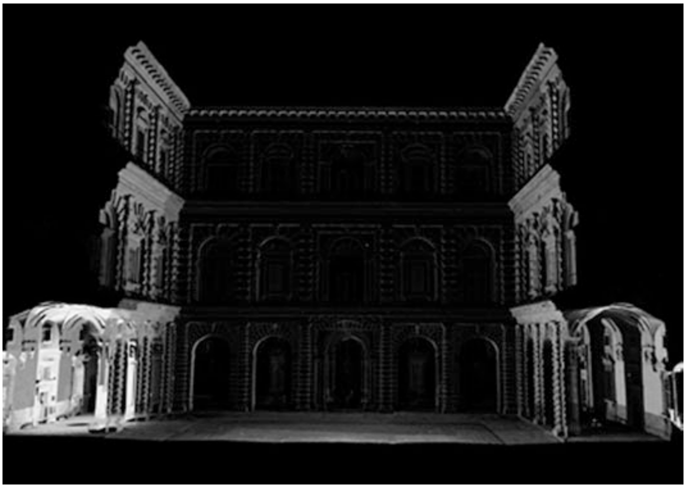

Fig. 7 Giovanni Pancanni: imagen de scanner 3d del Palazzo Pitti. 2016. http://www.giovannipancani.it

5 Form

But furthermore, once we know the object by drawing, or maybe at the time we are drawing, we could want to understand its nature, its reasons, the structure that order its parts. We are talking about issues related to geometry and measure and to possible com-positive derived laws. The integration of the parts into a whole, the eternal problem of Architecture, has been studied from various points of view, often contaminated by ideological positions, but almost always linked to the act of drawing. The simple recognition of the parts and the necessary identification of the rules of their linkage seem to need Drawing. It discriminates and decides, translating the reality (replacing it) using graphical meaningful units, transforming it into concepts utilized in logical processes. The use of these concepts, which have to do with the very instrumentality of the drawing process, opens a fascinating field that is

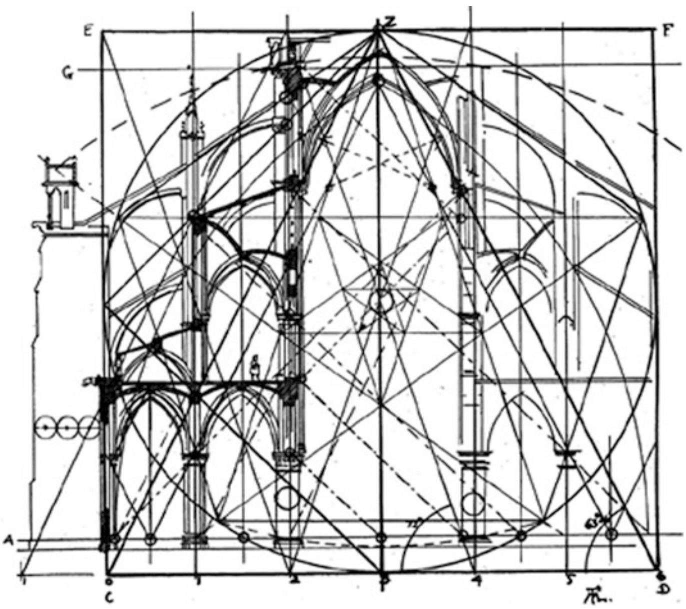

Fig. 8 Lund (1921)

at the root of many of our goals in Architecture knowledge. Perhaps it is due to the fact that many of these concepts have also identity in Mathematics, or in Geometry as a part of it. The amount (the measure), the ratio, the proportion, the transformation etc. are related to the underlying order, modulation, repetition, the law of generation, the hidden geometry etc. It seems that Architecture (thanks to the mediation of Drawing) resonates with the objectivity of Mathematics. We may remember here many works, from Leonardo and Dürer to Durand[7] (1817–1819), from Villard d'Honnecourt to Lund (1921) (Fig. 8) and Ghika (1927), or to the current attempts to scientifically substantiate parametric architecture. The causes of the form of architectural objects are sought following a systematic process regulated by Drawing, in which intellectual activities (inferences, deductions etc.) and empirical ones (graphical chained sequences) are mixed. It seems we approach fairly closely to the definition of research given above.

[7]Particularly significant in this respect is the Durand's *Précis de leçons d'Architecture* (1817–1819).

6 Proposition

Besides the historical treatises of Architecture, which deserve a separate attention, another field of inquiry related to Architecture in which Drawing is irreplaceable is *proposition*. Drawing has intervened steadily here, with a different involvement in the research process, but it has always been present in the expression of results. We do not include here the definition of a new architecture itself (the project), but the approach more or less general to solutions that have to do with it. A line of work that slides, admittedly, in the borders of objective knowledge. But a very old line that refers to the proposed rule, the presentation of exemplar models with the aim of being considered as a source of knowledge. These propositions were carried out in response to different motivations and in a framework of reasonableness determined by their time. Let us remember the many editions of Vitruvius, in which the initial absence of drawings was exploited for introducing an almost ideological statement (Cesariano in 1521, (Fig. 9) Barbaro in 1556, Perrault in 1673…) and let us take a look at the many exciting proposals for the classical orders (Vignola in 1562, Scamozzi in 1615…) at the *Architecturonographie* of the nineteenth century in France, or at the retrospective and more or less truthful narration of exemplar or inspiring architectures, as drawn by Serlio in 1517, Palladio in 1570, Fischer von Erlag in 1721, Boffrand in 1745, Blondel in 1752–1756, Vittone in 1760, Peyre in 1765, Ledoux in 1804, Schinkel from 1819 to 1840[8] or Wright (1910) (Fig. 10) and many others.

Other inquiries raised from Drawing refer to proposed material solutions, trying to answer the recurring question: How must we build? From general systems to the specific constructive detail, this research has been able to focus on helping to build, universally and using the contemporary available technology. Unique proposals, catalogs of solutions and descriptions of procedures have been defined and expressed by drawings (Blondel 1771–1777). Some cases are exceptionally exemplifying. Stereotomy or Graphic Static show the powerful instrumentality of Drawing in order to build first and to know Architecture after. Some other researches, at the service of the production of Architecture, have to do with what might be called an empirical design process. Ergonomics or the catalogs of useful measures could be a good example (Neufert 1936) on how Drawing is the essential tool of searching and expression of conclusions.

[8]We refer to Serlio's *Tutte l'opere d'architettura et prospettiva*, to Palladio's *I quattro libri dell'architettura*, to Fischer von Erlag's *Entwurff Einer Historichen Architectur*, to Boffrand's *Livre d'architecture*, to Blondel's *Architecture françoise*, to Bernardo Vittone's *Instruzioni elementari per indirizzo de'giovani allo studio dell'architettura civile*, to Peyre's *Oeuvres d'architecture*, to Ledoux's *L'Architecture considerée sous le rapport de l'art, des moeurs et de la legislation* and to Schinkel's *Sammlung architectonischer Entwürfe von Schinkel enthaltend theils Werke welche ausgefürt sind, theils Gegenstände deren Ausführung beabsichtigt wurde*.

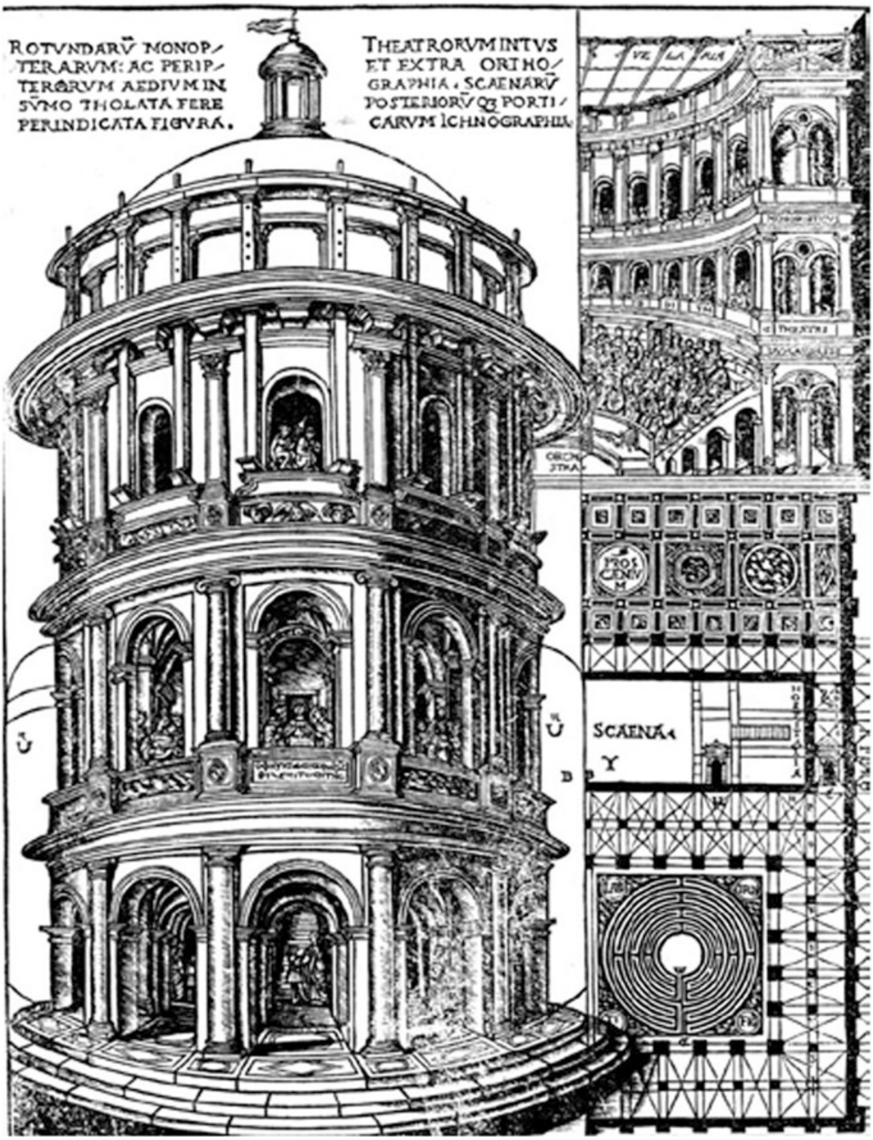

Fig. 9 Cesariano. 1521

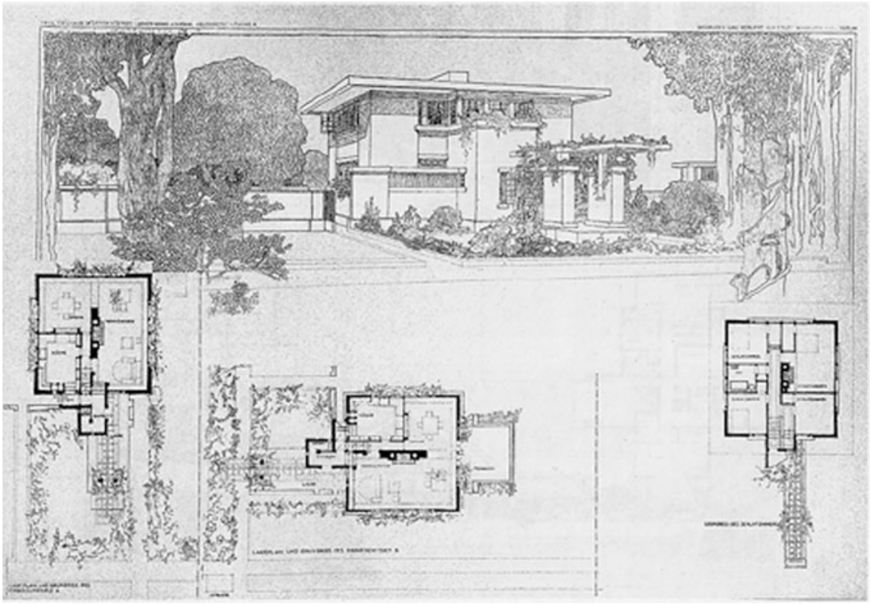

Fig. 10 Wright (1910)

7 As a Final Thought

We could go on with a caseload that would be prolix to excess. Those who believe that there is an almost ontologically indistinguishable continuum between architecture, city and landscape could keep reminding researches drawn on a different scale. It would be consistent. And we would find numerous examples. Anyway, for all that we have considered, it seems that an evidence pursues us: in any inquiry into the essence of Architecture, namely, into their material-spatial condition and intellectual foundation, Drawing is essentially involved. With some controversial intention, we could recognize in that essence the architectural form, understood in its most generous and unprejudiced sense. Form as conclusion. Form as integration of solicitations. Form as the object of knowledge and proposition in Architecture. Form, in short, as an actual expression of Architecture (in capital letters) and as a synonym of architecture (lower case). Form that can be described and known by dissections, simplifications, checkups etc. only possible with Drawing that tests and errs, that repeats and adjusts, that links and overlays, layer by layer, paper on paper, step by step, reason after reason, argument after argument. A Drawing that guides, finds and concludes.

Considering all the above, we should perhaps conclude with a series of linked statements, with which we could agree on:

- Knowing means to put into action the intellectual faculties to find out issues related to the essence of the objects (its nature, attributes and relationships). That knowledge must be universal. Research should seek to increase knowledge. It must therefore reach objective conclusions through a systematic process, using intellectual and experimental processes.
- The above statements are fully valid in relation to Architecture.
- Drawing—with its inherent limitations of internal articulation, but with the advantages provided by its essential confluence with Architecture—is the specific language of this discipline.
- Any process of knowledge or research in Architecture that is interested in essential issues (not contextual) involves the form, understood in its broadest sense, as conclusive integration of different levels (volumetric, spatial, functional, constructive, semantic etc.).
- Any approach to architectural form, either of knowledge or pragmatic, needs a greater or lesser extent of Drawing to be developed and completed.
- Drawing may be therefore the essential methodological element of a systematic research process and the material expression of its conclusions. This statement becomes categorical when the architectural form is involved in the object of study.

Let us not forget. And let us not despise the research in which Drawing plays the leading role. We would incur a large error of assessment and would forget centuries of progress in the understanding of Architecture.

On the other hand, is it not a pity that all this needed to be expressed by words?

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Traces of Stone Cut in a Fragment of the Royal Chapel of the Convent of Santo Domingo de Valencia. Drawing and Construction

Pablo Navarro Camallonga

Abstract The “Santo Domingo” Royal Chapel is one of the most important works in the Spanish context of the fifteenth-century. The great vault is a peculiar work which involves several issues to understand its construction. There isn’t any graphic file about this groined vault with double curvature, thus, its design and construction has to be discovered by hypothesis. The present article explains some introduction about its traces and the several hypothesis that has been carried out, in order to define the carving of their pieces.

Keywords Vault · Gothic · Stonework

1 Introduction

Santo Domingo Royal Chapel (Fig. 1) is probably one the most important architecture pieces built in the city of Valencia in mid fifteenth century, and it is also one of the most complex pieces at the moment. Santo Domingo Royal Chapel was ordered to be constructed by King Alfonso II the Magnanimous in order to receive his grave, although it finally did not take place: The King stayed in Naples and the construction of the chapel was not yet finished. However, the construction of the chapel was made by the best “stonemason” or “architect” at the moment: Francesc Baldomar (1425–1463).

This building is one of the most sophisticated architectural constructions at the moment in Europe (e.g., Diamon domes in Germany, Renaissance works like the dome of Santa Maria dell ‘Fiore in Italy, and the Cathedral of Seville in Castile, are being built at the same moment). However, the Royal Chapel shows a number of peculiarities that does not exist beyond the limits of the ancient Kingdom of

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Fig. 1 Royal Chapel views, at Santo Domingo Convent, Valencia

Valencia. We refer to a specific type of work: double curved surfaces nerveless vaults.

2 Construction Traces, Previous Aspects

Unfortunately, today we do not have any historical graphic drawing documents of this particular type of vaults. So, in the entire corpus of manuscripts from the early sixteenth to seventeenth century, we found many detailed groined vaults, but they are all simple[1] rectangular[2] types: quadrilateral also called “perlongada”[3] with an edge flat or “ab engauxit”[4] (with roll), but we find no description of the complex vaults with double curved surfaces, designed for the first time, surely, by Francesc Baldomar.

However, this theoretical corpus, (even not having this particular constructive case) represents certainly the range of geometric tools that architects of the time had. In other words, despite not having the specific trace, we have the resources with which Baldomar projected the complicated vault.

[1]This kind of traces appear in several manuscripts along the XVI, XVII and XVIII centurys. From the manuscript of Pedro de Alviz (which is one of the earliest copies) until the Vandelvira treatise’s manuscript.

[2]Vandelvira (1580). Fol. 43.

[3]Vandelvira (1580). Fol. 44.

[4]Gelabert (1653). The author makes a subtle difference and details those vaults that have their edges contained in planes (i.e. edges that are technically ellipses) and those edges that are not contained in planes and are therefore technically 3° curves.

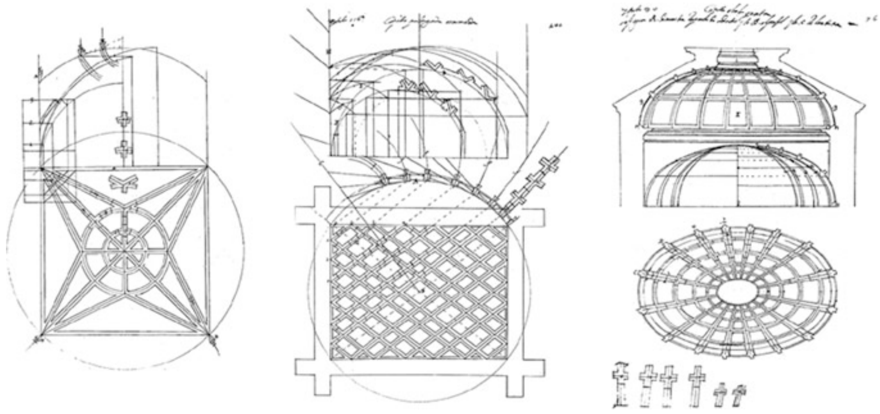

Fig. 2 On the *left*, an example of a drawing without dihedral correspondence, a "terceletes" vault (Vandelvira 1580); In the *middle*, a vault of "cruceros", without dihedral correspondence also (Vandelvira 1580); *right*, oval vault drawn in dihedral correspondence (Vandelvira 1580)

So, the main subject of this article is a brief tour of all these documents, looking for tools that allow us to solve the problem of tracing Baldomar vaults.

3 Drawing of "Elevations" and "Plants". The Art of Design and the "Montea"

As shown in the manuscripts (from the earliest—Braz of Álviz[5]—until the later—the manuscript of Gelabert[6]), the master stonemason, usually begins drawing a schematic plan and simple lines representing the nerves. And on these lines, normally, he draws arc curvatures in precise magnitude.

The proceeds of the stonemasons when depict "plans" and "elevations" is not systematic. The most common is to draw the plan, and then, in any part of it, the true magnitude of the edges. However, this is not always true, and in some cases projections are drawn correctly,[7] probably, for some practical reason or some particular purpose (Fig. 2).

[5]De Alviz (1550).

[6]Gelabert (1653).

[7]Vandelvira (1580). Fol. 147. On certain occasions Vandelvira using the procedure of drawing the projection with all possible geometric rigor taking into account the limitations of his time. Is the case of the "capilla obal quarta" which draws plan and projection, performing a beautiful section along the major axis.

4 Curves and Projections Resulting of Intersections. Approaches to the Ellipse

Knowledge of tracing ellipses begins to generalize in S XVI. Personalities such as Dürer,[8] Serlio,[9] recover the trace of a complex curve which is already described in "Conic sentions" by Apollonius of Perga (III c) In fact, the manuscript of Hernán Ruiz show us an ellipse[10] (an intersection of a plane with a cone) as described by Dürer (probably copied it).

However, a detailed analysis of other manuscripts, such as Pedro de Alviz,[11] Vandelvira,[12] or the latest of Gelabert,[13] reveals some important things, particularly in cases of simple edge vaults. In these traces what is done are approximations to the ellipse finding intersection points, and then, joining by arcs.

What is done in this cases, is to find a number of points outside the ellipse, and after, join them with circle arcs; for example with radius on groups of 3 points, as Gelabert says.[14] Therefore the ellipse is simplified to a concatenation of different arcs without the need to be tangent, because these small imperfections in work are not perceptible (Fig. 3).

5 Drawing of the Chapel's Plan (Fig. 4)

Having conducted an analysis of the measurements of the chapel (which by extension is omitted in this article) and a brief tour of practical aspects of medieval and Renaissance stonework, it will proceed to elaborate the trace and a project hypothesis of the chapels fragment, reaching the entire stereotomic definition of one of its parts, as an illustrative example.

To trace the plan of the chapel is a simple task. It can be done easily by taking as a first point two cube, and then tracing the head of the chapel; defining the leading edges of the octagon and using right angles, 45° angles, and its bisectors.

[8]Durero (1525), p. 30.

[9]Serlio (1566), p 12r.

[10]Ruiz el Joven (1550). Fol. 54.

[11]De Alviz (1550). Fol. 43. In this sheet appears the trace of the cloister corner, in a rectangular plan. The layout of the ellipse is approximated probably made in installments.

[12]Vandelvira (1580) . Fol. 44. The first example of many that appear in this manuscript copy of the treaty is also the corner of the cloister.

[13]Gelabert (1653). Fol. 55r. Gelabert always eludes draw the ellipse, so that this curve is as a result of a material process of the working of the Stone.

[14]Gelabert (1653). Fol. 56r. For perlongada dome edge, it's interesting how one of the two cylinders approximates the ellipse, but it is drawn with different successive arches every 3 points each.

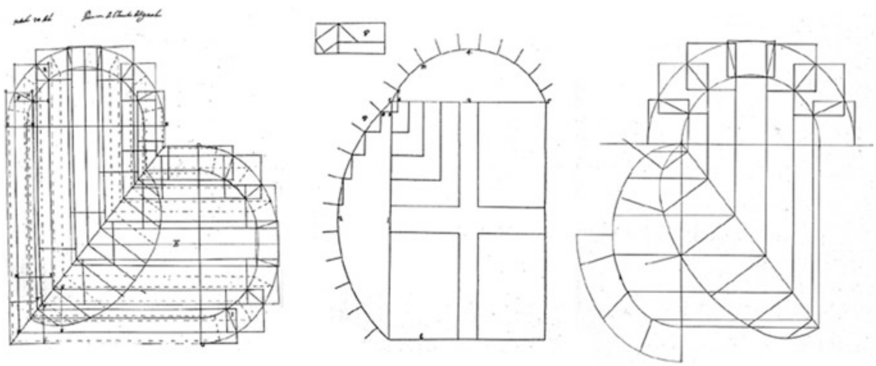

Fig. 3 *Left* Cloister Corner (Vandelvira 1580, 24); *Middle*, Rectangular chapel (Gelabert 1653, 55r); *Right* Cloister Corner (de Alviz 1550)

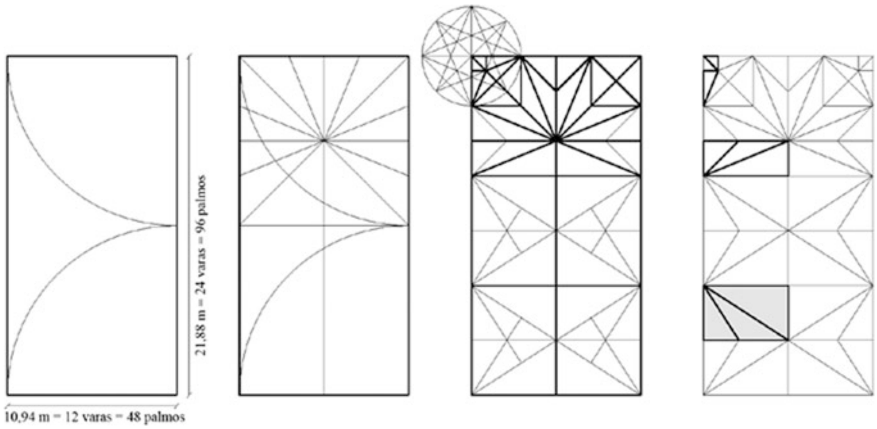

Fig. 4 Plan of the Royal Chapel, based on the geometry of the double cube. On the *right side*, the same plan with the four modules of the vault

Subsequently the remaining rectangle is divided into two parts and diagonals and "terceletes" are drawn.

Once the plan is traced, we can define the edges that define the vault to subsequently define the surfaces. For this reason we have considered the partition of the vault, or the consideration of repeating modules that define the entire space. These are identified in the plan and each will perform an analogous trace process.

The present article it is going to study a specific module section of the vault, shown highlighted in gray in Fig. 4 with the intention of defining the cutting of the stone blocks.

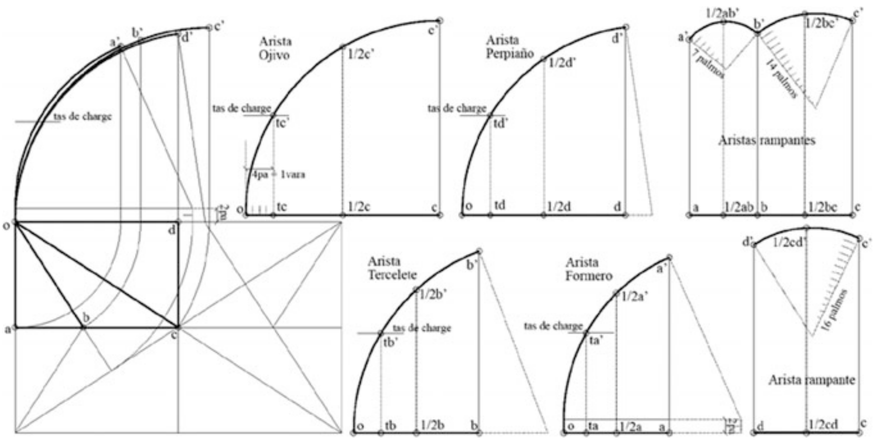

Fig. 5 "Montea" (plan and elevation) of the edges forming the modular vault fragment being analyzed

6 Tracing "Monteas" and Placing the "Tas de Charge" (Fig. 5)

Edges in true scale will be placed on a horizontal line, or "flat line" (called by Alonso de Vandelvira). It is particularly important not to ignore the risers that have been considered in the measurements (specifically in the "formero" arch).

After tracing all edges, we can not be overlooked is the situation of the "tas de charge", that is the horizontal plane defined by the top course of the wall that still contains the vault. Until this plan, the geometry of the vault belongs to the wall and its construction system, and from this plane, the joints begin to turn the space. And the height of that plane is given when the flight reached the diagonal arches on the wall is 0.98 m, or in other terms, four valencian palm.

7 Finding the Intersection of Planes with Edges. Hypothesis of Traces (Fig. 6)

Once the edges and the "*tas de charge*" are defined, we should proceed to solve the problem of its intersection with the planes that turn onto the module of the vault, to be able to geometrically describe the joints. These planes always flip around the edge, and intersect all surfaces of the vault fragment.

After placing the edges in accordance with magnitude, we should just project them on the diagonal to find the intersections with the different planes (Do not forget that the planes perpendicular to the edge revolve diagonal or diagonal arch).

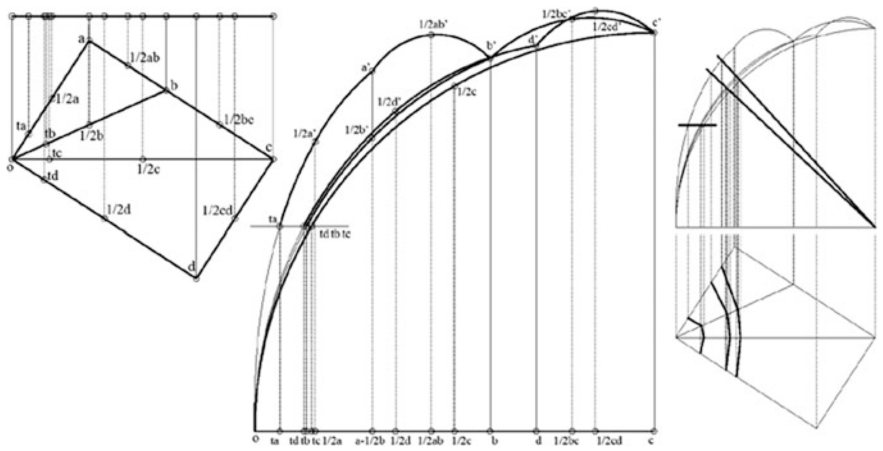

Fig. 6 "Projection" of the edges (*left*) and intersections with the planes of the joints between blocks

This process (from the point of view of the present descriptive geometry) consists in drafting a series of ellipses, finding their centers, then their major and minor axes to finally define the arcs. But in the case of a hypothesis of fifteenth century trace, it does not make sense to use a descriptive method developed after the context of the work. What will be done is to move the coordinates of specific points, to unite them with a series of concatenated arcs and finally, make an approach to the ellipse. This is what was done in the corpus of manuscripts preserved.

Additionally, in this corpus of documents there is no single solution to resolve the subject. Sometimes, the authors solved the projection with different solutions; concatenated different 3 point arcs, also concatenated every 2 points (all with the same radio), etc.[15]

Based on a criteria of simplification, and to use the least possible different arches, it seems that the most practical option is to take a single radio edge, but not to the full extent of the arc, but only in the part of the vault that remains above the "tas de charge", marking this with 3 points (as shown in the figure). We should just complete the projection of the edges at the bottom to "tas de charge". To solve this problem, nothing needs to be drawn, because defining the intersection of edges with the "tas de charge", the other intersections describing the lower joints can be like the first one, but changing the scale (which is geometrically imperfect, and constructively imperceptible).

[15]To do this, several tests have been conducted since the only radio to numerous points to several radios. It is perhaps the most powerful mystery of this investigation, since from a projection will find stone cutting templates. For this reason it was decided finally by the criterion of simplification to a single radius for each edge, taking the points: "tas de charge", the tip of the bow, and one in the middle of the edge on the ground.

Once this is done, we just need to put the joints together and find the projection on the plan, one by one, which in the context of XV century, it is feasible to do full-scale on a stakeout on a prepared flat surface (plaster, with ocher paint, as indicated professor Zaragoza (Tolosa Robledo and Zaragozá Catalá 1996) through the documentation of payments surviving work).

As the work is performed safely by rows one by one, in stakeout, each course will be placed the moment. In other words, the planes will be placed one to one as the work progresses. This explains the fact that the angles of the stones vary randomly and **are** not maintained constant.

8 Tracing the Severies (Fig. 7)

To make the traces of the serves it is necessary to find the real magnitude between corresponding pairs of points from the edges. The analysis of the measurements shows that are circular traces without any error. One possibility is that these curvatures are staked in construction, but to be able to totally draw them we would need to have all the pieces of the spun together to make the curve, which seems too difficult. In contrast, although is a very slow process, calculate true quantities is easily executable. And this calculation is done as Vandelvira, Gelabert and other authors of the sixteenth and seventeenth centuries,[16] and consists of a simple turning operation as shown in the figure.

Then, it is necessary to find the true magnitude between points, and draw the arc curvature corresponding to the data obtained in the analysis (60º arches in most cases). It is a process that will have to be done course to course, while the joints plans are placed.

9 System of "Obtaining Templates" or Working of the Stone Block

Get templates for styling of the blocks, after carrying out the explained process is not overly complicated. It closely resembles the classic method called "thefts method", but more sophisticated because of the double curvature surfaces. In essence, the first step is to locate the main planes defining joints with the proper angle, and then trace the curvature of the pieces. Given the big number of different pieces of the vault (but all are encompassed by the same trace system) for this article, we decided to develop an only one singular block type, situated on the "tercelete" edge.

[16]Palacios (2003). Ed. Mulinallera. 2003. 391 p. ISBN 9788489150607, p. 25.

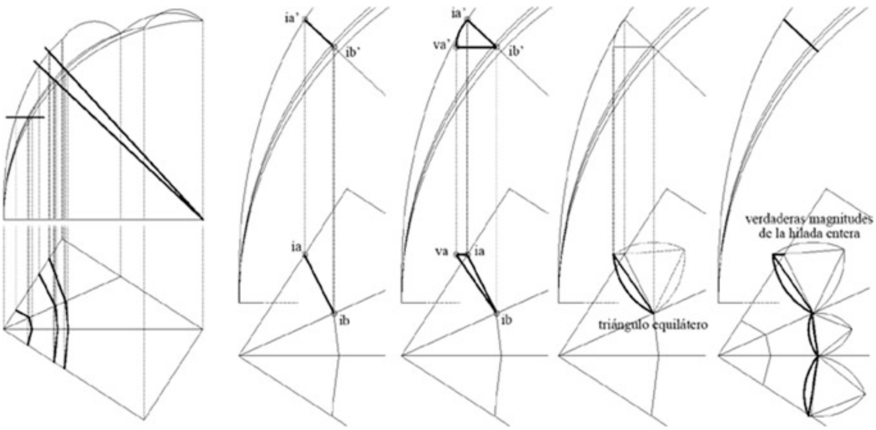

Fig. 7 Drawing of the different surfaces in the vault. *Left* intersections of planes with edges. In the *middle* the real magnitudes. *Right* example tracing the curves

10 Delimitation and Obtaining of the Envolving Piece Template (Fig. 8)

Firstly, we should define the master plan, the corresponding row you want to build, its trace and the curvatures in true magnitude, as previously has been detailed.

Then we should locate on the plan the envolving plans of the piece in vertical planes. Vertical planes are defined in parallel to the projection of diagonal arch lines, so to define a block, it is only necessary to trace 2 parallel lines to the diagonal arch edge projection. If the details of the chapel construction are observed,

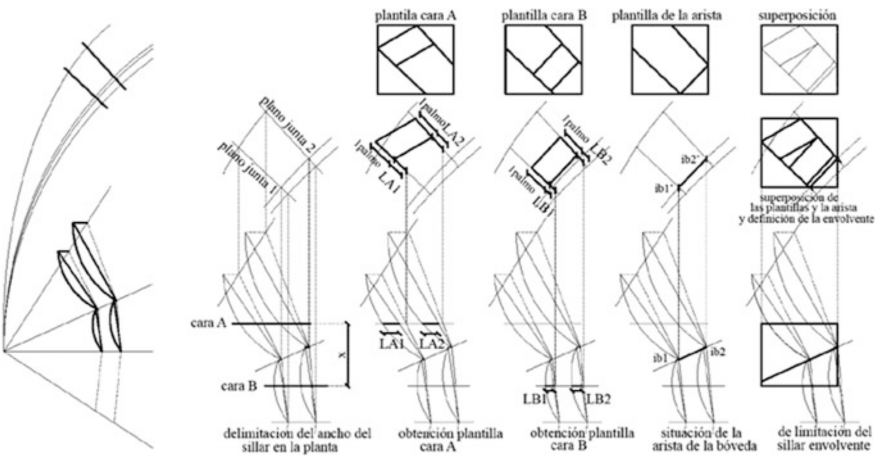

Fig. 8 Drawing the delimitation of the envolving stone, and templates for styling, corresponding to side A, side B, and the edge

it is appreciated that these distances (distance x in Fig. 8) do not have a fixed size. That change is presumably because of the different sizes of the pieces than arrived previously, parallelepiped-shaped cut.[17]

Then the distances are marked in true magnitude of the straight line to the curvature of the supplement (LA1 and LA2) for both sides. These magnitudes and the edge itself will allow to define the interior surface of the vault. Whereby, we should only define one thickness, which can be determined "by eye" (a span, for example, as shown in Fig. 8) or by the size of the blocks that are coming from the quarry. We should not forget that this work is basically an interior space, so that the exterior surface of the vault, will be imposible to see, and it is not necessary to finish it perfectly.

With the envelope, defined in the edges projection for each of the faces and the edge, all dimensions can be transferred to the plan delimiting the enveloping rectangular shape. Obtaining, by this way, the templates to cut the block.

11 Ashlar Carving Process (Fig. 9)

The "envelope" piece is placed in the plan traces (presumably on the ground, in the case of the real work) and its templates placed on their vertical walls, and marked on the edge projection.

With this, the first to be made is the working of the two inclined planes defining joints. Once carved, it will redial on them the status of edge and the corresponding points obtained by the templates.

In this way, it is only necessary to draw between the points on the surface the joint (or surface) curvature. These radios are as defined above and only need a staff to transfer to the block.

Finally, we should ensure that the curvatures of the templates are the correct, and thus remove the excess stone to finish defining the piece. The curvature of the edge and of the front ends is performed with a single radio "baivel" (a kind of template). So, at this point, a double-curved surface doesn't need anything more than the skill of the mason to achieve the desired shape.

12 Conclusion (Fig. 10)

This article highlights a series of hypothetical traces of stone vaults of one foremost important examples in the Spanish construction of the XV century which had barely been analysed from the point of view of the sternotomy. Some studies focus

[17]Tolosa Robledo and Zaragozá Catalá (1996), vol. 2, p. 32. The documentation work payments preserved in the Royal Chapel reference to "contraplantillas" or "contramotles" for stonecutters who worked in the quarry is probably designed these templates to contain the envelope of the final pieces to built the chapel.

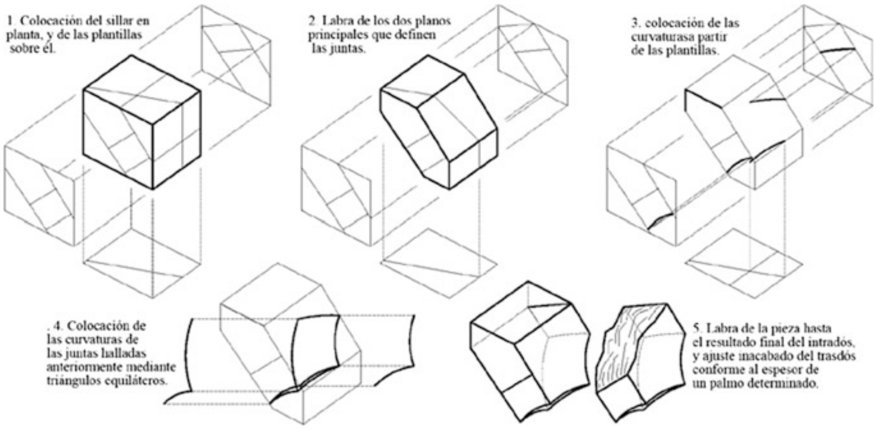

Fig. 9 Image of treating of ashlar. On the *left* it is shown seated on the ground, then placed with templates and sharp edges after both principal planes and styled after the curvatures defined on it, and finally finished, ready for disposal on site

Fig. 10 View of a section of the dome of the Royal Chapel with an outstanding ashlar similar to that which has been analyzed in this article

towards an analysis of dimensions and surveys, but rarely come to define aspects that relate with the plans being made to carry out the cutting of rock and construction work. Here, we present a hypothesis that (although we can not assure that is true) we can ensure that all geometric tools used were known at the time, and also allows to obtain a valid system of traces.

There are numerous themes that we have not been able to develop, as the working of the pieces between the modules of the vault, the "enjarjes" (the lower part of the vault), etc. because of the extension demanded for the article. These aspects are part of the research that this author is developing and that will be an important part of his Ph.D. thesis.

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The Roman Amphitheatre in Tarragona, Five Centuries of Drawing and Still Unsatisfied

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Abstract In the monumental complex of the Amphitheatre of Tarragona we encounter the confluence of two singularities. On one hand, over the past five centuries, the amphitheatre has suffered a series of profound architectural changes. On the other hand, we have been fortunate that many of these transformations have been documented by means of drawings, engravings, plan surveys and, since the early 20th century, by photographs. Graphic reproduction of Tarragona's Amphitheatre is interesting in itself if we take into account the evolution of drawing techniques. The objectives of these graphic reproductions were the manifestation of the obsessions of different periods.

Keywords Drawing techniques · Amphitheater · Tarragona · Heritage

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1 Introduction

In the monumental complex of the Roman Amphitheatre of Tarragona we encounter two singularities that come together. On one hand, the original building had been the object of numerous and profound architectonic transformations that, in fact, are the motive for the use of the expression *monumental complex*. These transformations include the insertion of a Visigoth church, as well as the superposition of a Romanesque church which would eventually evolve into a convent. Until the late 18th century, the convent alternated its religious function with that of a military encampment that existed during different periods of warfare due to its strategic location outside of the city and near the shore. Furthermore, during the 19th century the site hosted a prison. In the 20th century the convent/barracks/prison structures were removed, the recovery of the Romanesque church was attempted (with unfortunate results, as we shall see) and the entire general area was excavated to the original level of the amphitheatre arena. These interventions brought to light the Visigoth basilica of the late 6th century, over which the aforementioned Romanesque church was built during the mid-12th century (TED'A 1990; Ciurana et al. 2013). The second singularity is that the majority of these transformations were, fortunately, recorded by means of drawings, engravings, floorplans and, since the early 20th century, by photographs.

These abundant graphic reproductions constitute a fundamental basis for a historiographical analysis that permits the interpretation and visualization of the evolution of the complex. Nevertheless, the aforementioned production also has its own identity if we consider the study of the evolution of the representation techniques.

2 Wyngaerde and Pons d'Icart

The first identification and description of the structures of the amphitheatre were performed by the Tarragona native Lluís Pons d'Icart, in the second half of the 16th century, in his book *Libro de las grandezas y cosas memorables de la Metropolitana Insigne y famosa Ciudad de Tarragona* (Pons d'Icart 1572, 215). This analysis was erroneous, due to the fact that he considered it a "theatre". In the preliminary notes of the publication, however, he labels it as a "coliseum" (Duran 1984). It is probable that in the drafting phase of the *Libro de las grandezas* he met Anton Van den Wyngaerde (Remolà 2003) in Tarragona during his stay in 1563. Van den Wyngaerde was a Flemish painter commissioned by Philip II to draw numerous views of several cities, among them Tarragona. Wyngaerde devoted two sketches to the portion that was visible at that time, the south tier structure of the amphitheatre (Fig. 1). In a general view of the city drawn from the sea, (Fig. 2) we can also identify the support vaults of the *cavea* with the medieval church of the *Miracle* in the background.

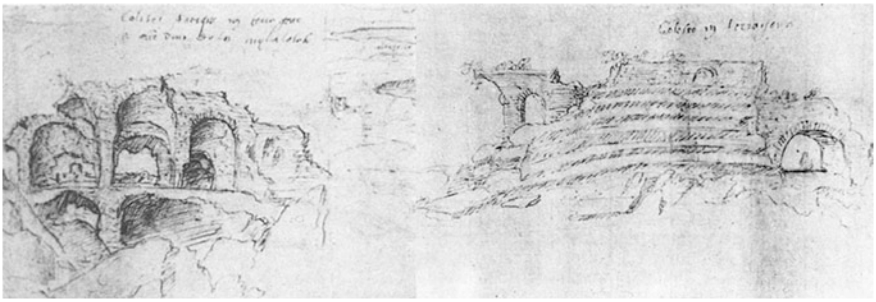

Fig. 1 Anton Van den Wyngaerde, 1563, sketches of the support vaults and the tiers of the south *cavea* of the Amphitheatre of Tarragona, preserved in the *Victoria and Albert Museum,* London. Original codes: (95-H-54) 8455-13 (r)/(95-H-54) 8455-13 (v)

Fig. 2 Anton Van den Wyngaerde, 1563 Overview of Tarragona from the sea, preserved in the *Ashmolean Museum* in Oxford. Original code: B-II-478 (r)

Wyngaerde started his services to Felipe II in 1557, accompanying him on military campaigns through the Netherlands and spending short periods in England (1558) and Rome (1560). Previously, beginning in 1543, he had worked for the prior monarch, Carlos V, following him in campaigns through France and Germany, as well as England, Netherlands, Naples and Genoa (Galera 1998).

Pons d'Icart was an attorney for the clergy of the Cathedral Chapter and also a General Appellate Judge in the city of Tarragona (his probable birth place), where he settled in 1545 once he completed his studies. The information we have about Pons d'Icart is limited, it comes mainly from what he explains in his own work.

Wyngaerde sketched the vaults on the left margin of a large drawing in which he framed a general view of the city coastline (Fig. 1). The detail of the amphitheatre is represented in a completely different scale from the rest of structures that appear, but he locates it near its actual position in the panoramic view. It is reasonable to think that the general sketch of the shoreline is an earlier drawing, which would have served Wyngaerde to have a comprehensive understanding of Tarragona. It is possible that he observed the structures of the amphitheatre while working on the panoramic view

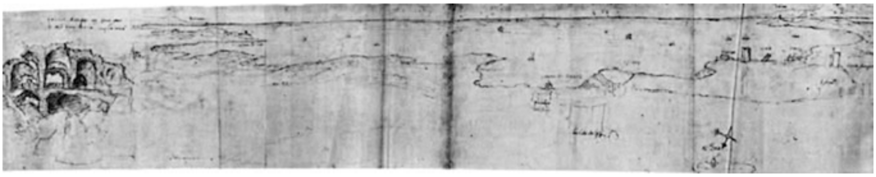

Fig. 3 Anton Van den Wyngaerde, 1563, sketch of the Tarragona coastline. Preserved in the *Victoria and Albert Museum*, London

from the sea, a drawing that he did complete. At some point, before or after boarding from the *Miracle* beach, he reused a discarded drawing in order to take some notes. The sketch of the interior of the tiers is on the backside of the sheet (Fig. 3).

The two sketches show us the southern tier of the amphitheatre with a very similar appearance to which we can see to this day. It is interesting to note that Wyngaerde dedicated special attention to the Roman remains during his visit to Tarragona, a rare occurrence in his previous work, despite having visited Rome itself. Evidence of this is that in his sketch he ignored the *Miracle* church, which we can clearly perceive in his general view of the city from the sea. It is possible that Pons d'Icart influenced the Flemish artist in order to reflect the *Tarraco* described in his *Libro de las Grandezas*. It is known that Wyngaerde performed various sketches of Roman structures in his visit to Merida later in 1567.

3 Fischer von Erlach

A long period of time must pass, until the War of Succession in the beginning of the 18th century, in order to find the next view of the monumental complex of the amphitheatre (Fig. 1). It is an engraving included in an essay on historical architecture published by Fischer von Erlach (1721), created from a 1711 drawing by the engineer Antoine M. Weiss. It is a panoramic view of the city from the sea, slightly to the east of the remains of the southern tier of the amphitheatre. The structure of the tier and the *Miracle* convent ('*Le Convent des Trinitaires*') constitute the foreground of the image, forming the base of the south-east corner of the urban centre, which we see in the upper right area, presided by the tower presently known as *Pretori* ('*Châteaux de Cesar*'). The view extends in a westerly direction encompassing a broad segment of the coast.

Between the 1563 Wyngaerde drawings and the drawing of 1711 that served to frame the Fischer von Erlach engraving almost 150 years had transpired, during which a number of changes in the use of monumental complex occurred. In 1576, the clergy of the Cathedral yielded the *Miracle* church to the monks of the Holy Trinity, the Trinitarians. Due to the siege of the city in 1644, during the War of the *Segadors*, the Trinitarians abandoned the convent to seek shelter within the perimeter of the city walls. It seems that the structures of the convent were seriously

Fig. 4 Engraving published by Fischer von Erlach in 1721, from a 1711 drawing by Antoine M. Weiss (photo reproduction from History Museum of Tarragona)

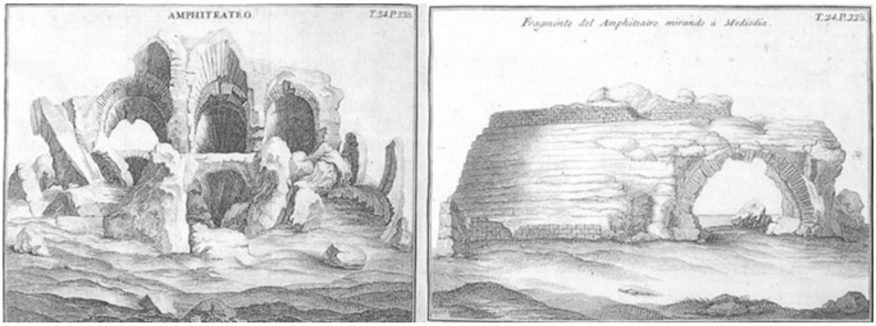

Fig. 5 Francesc Bonifàs engravings, exterior and interior views of the *cavea*

damaged (Capdevila 1924, 59). In 1707, the circumstances of the War of Succession changed the use of the Trinitarian convent into lodging for an English regiment. Beginning in 1710, the complex was used as a military hospital and in 1714 the Trinitarians returned.

The Fischer von Erlach engraving reflects the state of the complex at that moment it was being used as a hospital. It shows us the support structures of the southern tier, with trees along the crown of the structure. The vaults are formalized in a chaotic fashion, perhaps due to a lack of understanding and direct experience from the engraver about the reality of the complex (Fig. 4).

4 Francesc Bonifàs and Henrique Florez

In the second half of the 18th century, Francesc Bonifàs produces two engravings of the monumental complex (Fig. 5) in order to illustrate the *España Sagrada* by Henrique Flórez (1804). Flórez's work could be encompassed in the so-called

'Christian illustration', a type of Spanish version of French illustration and encyclopaedism. His writings are scholarly and critical but always adopting a religious point of view. He shows interest in the amphitheatre due to the fact that it was the scenario of the martyrdom of *San Fructuoso* and his deacons. He performed a detailed description of what was known, at that point, of its structures, which was perfectly complemented by the engravings produced by Bonifàs.

The framings of the Bonifás engravings are very similar to those chosen by Wyngaerde 200 years before. The crowning of the tiers is free of vegetation, perhaps demonstrating that the Fischer von Erlach engraving responded to an artistic desire to enliven the place. It is curious how Bonifàs fits the top level of the vaults in the view from the beach, giving the complex a very stylish appearance, almost with Gothic reminiscences. The stone block arches seem made of brick and can be distinguished traces of formwork almost invisible today.

When Francisco Bonifás composed his engravings the Trinitarians had not resided in the convent for 20 years, they had moved to the interior of the urban enclosure. They retained possession of part of the structures and yielded the rest to the king. Probably, this incomplete transfer of ownership of the complex was one of the reasons for the acceleration of its state of neglect.

5 Alexandre de Laborde

The amphitheatre deserved the attention of Alexandre de Laborde in his work *Voyage pittoresque et historique de l'Espagne* (Laborde 1807–1818), which also includes other engravings dedicated to Roman structures in Tarragona such as the *Arc de Barà*, as well as the *Scipion* and the *Pretori* towers (Augusto's Palace). In the case of the engravings of the amphitheatre, the drawings by François Ligier were used as the base for these plates. There are two views, one of the interiors of the *cavea* and the other of the support vaults of the façade oriented towards the sea. In the second (Fig. 6), the viewpoint is very similar to that of the engraving by Fischer von Erlach, but from a tighter angle and with a much more accurate fit of the support vaults.

The style of Laborde's views is both rigorous and dramatic. The setting has a romantic aspect with spectacular skies of bulky backlit clouds, elegant pedestrians contemplating the ruins, vessels navigating along the shore and a wealth of textures in the vegetation. They take full advantage of the expressive possibilities of the engraving technique, but the structures are represented faithfully, not indulging the imagination of the artist. Furthermore, you cannot discard that the view had a military purpose since it could have provided valuable information for the Napoleonic invasion at the beginning of the 19th century. It locates two forts, the position of the ships that could mark the appropriate areas for anchoring, and the topography of the coast that could permit the identification of appropriate areas for disembarking.

Fig. 6 Ligier original drawing to composed the view of the amphitheatre from the sea included in the *Voyage pittoresque* de Laborde

Fig. 7 The complex in the beginning of the 20th century. Vallvé archive, *Archivo Municipal de Tarragona*

6 The First Photographs

For most of the 19th century the amphitheatre surroundings were affected by the construction of the port and the railway adjacent to the sea. The convent of the Trinitarians became a prison (Fig. 7) where the forced labour workers were being held and destined for the port expansion. All the changes suffered by the historical complex of the amphitheatre and its immediate perimeter since the late 19th century had been documented photographically. The first images show the final phases of use of the convent of the Trinitarians as a prison, with structures at a much higher level than those of today, therefore making it very difficult to identify the site as the location of a Roman amphitheatre. Posterior photographs permit a visualization of the state of neglect following the usefulness of the prison. This situation will last until the archaeological works directed by Samuel Ventura in the second half of the twentieth century.

7 Antoni Nogués and Salvador Ripoll

In the year 1910, the Tarragona City Council obtains the ownership of the complex and decides to eliminate the structures that had been attached to the original Romanesque church in order to make it more visible, with the unfortunate consequence that once free of the core bracing that supported the main nave for centuries, it collapsed on the night of May 9th, 1915. An intense discussion about what to do with the church was initiated in regards to whether to restore or to continue with the demolition. This type of dialectic was no stranger to political trends of the period. The 'anticlerical' options succeeded and on February 3rd, 1923 a series of 20 dynamite cartridges were exploded demolishing a large portion of the structures of the Romanesque transept.

In 1934, the Archaeological Newsletter of the *Reial Societat Arqueològica Tarraconense* published the plans of the complex developed by Antonio Nogués Ferré, who composed a plate in which he created a hypothetical reconstruction of the contour of the enclosure of the amphitheatre and its section, basing it on the remains known to date attributed to the Roman building (Nogués Ferré 1934) (Fig. 8). He overlaid the plan of the Romanesque church (without the volumes of the convent, which were already destroyed) and the layout of various walls that formed the northwest corner of the prison enclosure.

Between 1948 and 1957 was performed an extensive excavation which permitted to disinter the arena of the amphitheatre and its trenches. Furthermore, it was possible to locate the remains of the Visigoth basilica beneath the Romanesque church, which, to that point, had only been referenced in writing without any material evidence. It is documented that the plans of the excavation were commissioned to the architect Salvador Ripoll (Sánchez Real et al. 1991), who during the 30s had already performed a plan survey similar to the one done by Antonio Nogués. Since the director of the excavations, Samuel Ventura, did not publish a description of this work, we were not aware if the 1950 plan surveys of Salvador Ripoll had actually been performed until we had a pleasant surprise while examining the documentation of architect Alejandro Ferrant stored in the Library of Valencia. Among the corresponding material of the reconstruction work that he developed in the Amphitheatre of Tarragona between 1967 and 1973, we found a magnificent topographic survey signed by Salvador Ripoll (Fig. 9), which was the first metrically rigorous plan survey of the monumental complex that has reached present day.

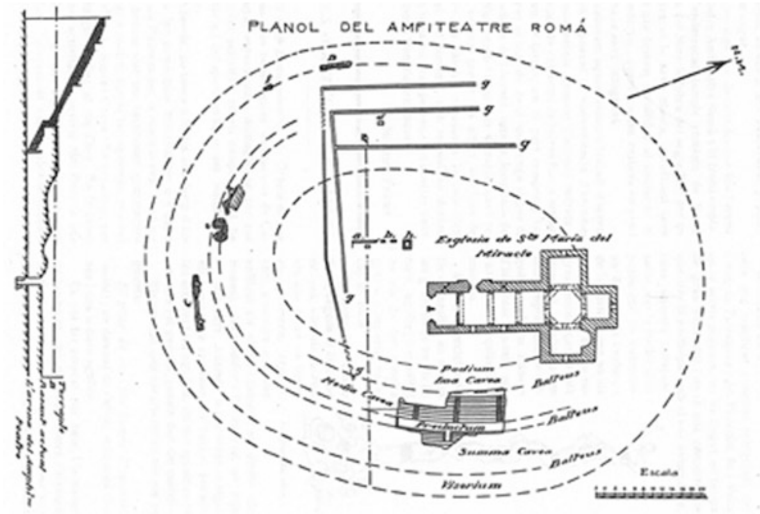

Fig. 8 Plan by Antonio Nogués, 1934

8 The TED'A Topographic Survey of 1990 and the Systems of Massive Data Collection

Until recently, the referential plans of the mapping of Tarragona Amphitheatre were those prepared by the *Taller Escola d'Arqueologia de Tarragona* (TED'A) during the excavation periods that preceded the publication of *L'Amfiteatre Romà de Tarragona, la basilica visigòtica i l'esglèsia romànica* (TED'A 1990).

In the year 2011, two final degree projects of the *Escola Politècnica Superior de l'Edificació de Barcelona* (UPC) conducted a photogrammetric survey of part of the original amphitheatre tiers, being the first time that these massive data collection methodologies were used for the documentation of the complex (Asens and García 2010). This work was awarded with the Luis Martín Morejón national award.

In order to develop an architectonic project in the amphitheatre, it was necessary to have a digital planimetric base in vectorial format (CAD). The TED'A survey was performed on paper and, consequentially, it was scanned and vectorised, but due to its comprehensiveness it was necessary to synthesize the geometry of the enclosure. Apparently, the arena matched the shape of an ellipse, but the most referential literature (Golvin 1988; Wilson-Jones 1993) indicated that key geometrical scheme of great roman amphitheatres was based on the use of ovals. This opened a new line of research, from which a doctoral thesis emerged (Toldrà 2013), and made it necessary to ascertain that the TED'A survey was sufficiently exact. We performed diverse digital photogrammetric studies of parts of the amphitheatre, a new conventional topographic survey (but now with completely digital means)

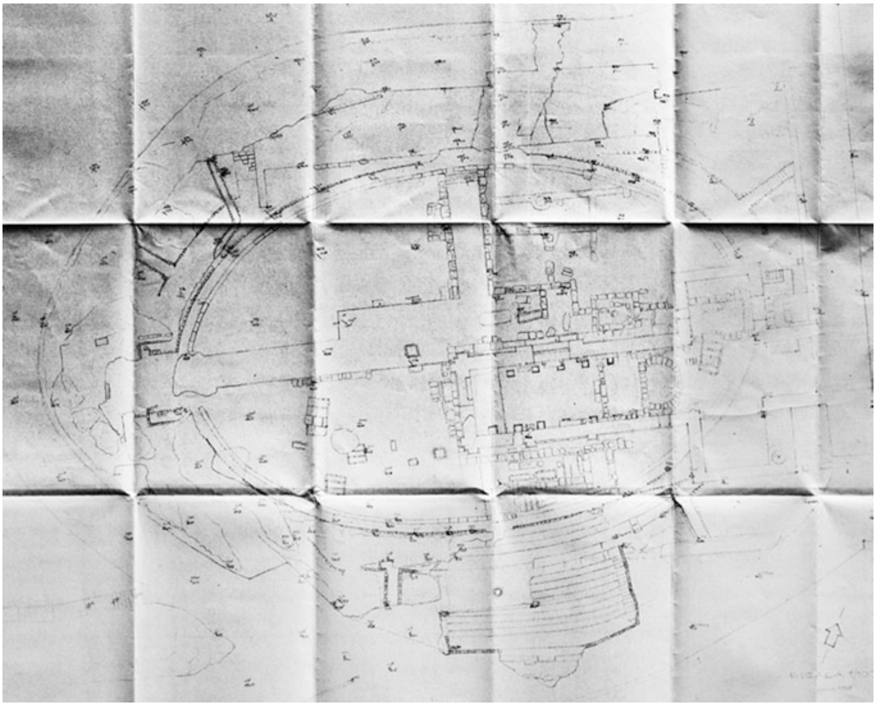

Fig. 9 Topographic survey of the monumental complex signed by the architect Salvador Ripoll. Reproduction of a copy located in the *Archivo Ferrant de la Biblioteca Valenciana*

and a laser scan of all structures (Fig. 10), therefore, converting the complex into a test laboratory of the latest optical systems for the massive collection of data.

Laser scanning has proved to be an especially powerful tool for the representation and analysis of the architecture of the monumental complex. The resulting model obtained has permitted the study of the sections of the tiers of the amphitheatre (Buill et al. 2015) and in the future can be useful for the scientific analysis of the monument (Macias et al. 2013) as well as for its management.

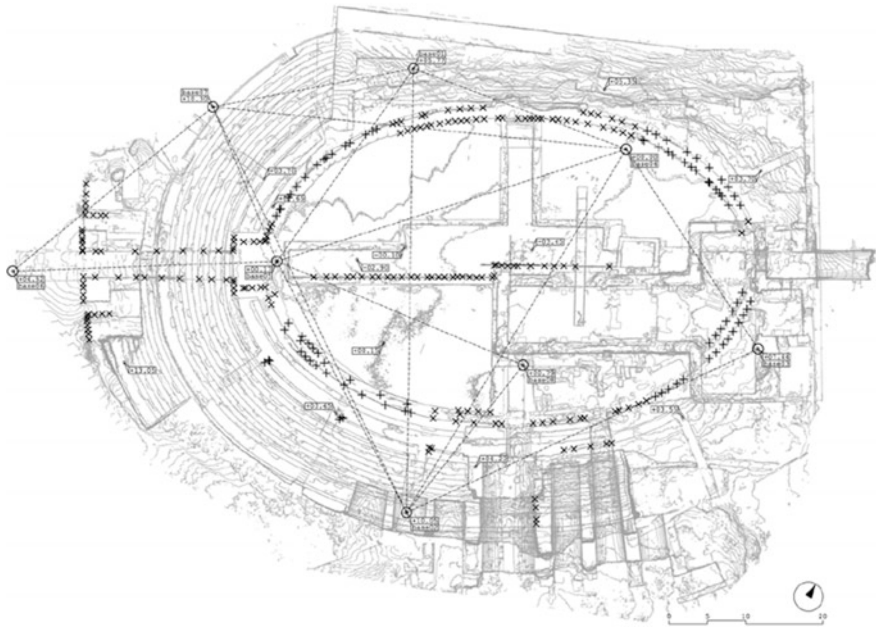

Fig. 10 2013 Laser scanning overlaid on the topographic control survey

9 Conclusions

Fortunately, the artists are not accustomed to exclusively cater to the petitions of their sponsors. Wyngaerde did not limit himself in just fulfilling the commission of Felipe II during his visit to Tarragona. In addition to drawing the panoramic views commissioned by the King, the Flemish landscape artist devoted time to some precise sketches of the remains of the Roman amphitheatre in Tarragona. Perhaps Wyngaerde had been influenced by Pons d'Icart, a native of Tarragona that wanted to manifest the antique grandeur of his city.

The amphitheatre was the central motif of the Fischer von Erlach engraving. His objective was to illustrate an essay on historical architecture, although the representation that we find of the vaults that support the tier nearest the sea, the only structure clearly distinguishable at that time of the Roman building, is extremely confusing and inconsistent with its constructive reality. On the other hand, it is possible that the engraving may be the best testimony that we have of the convent that was built at the beginning of the 16th century around the 12th century Romanesque church.

Henrique Florez's interest in the amphitheatre had a religious motivation. It was the scenario of Bishop Fructuoso's martyrdom, whose chronicle was one of the first written records that we have of Christianity in the Iberian Peninsula. But the engravings by Francesc Bonifás provide us with information of the state of a roman building in the second half of the 18th century, that we can contrast with the sketches by Wyngaerde and the engraving published by Fischer von Erlach.

For the prints by Laborde we propose a twofold objective. The first is stated and obvious: to illustrate an encyclopaedic work. The second, hypothetically: to provide military information that would be useful for the Napoleonic invasion at the beginning of the 19th century.

The intention of the planimetric survey conducted by Salvador Ripoll was to document the excavations directed by Samuel Ventura, and possibly was the reference for the pedagogical model of the excavation work exhibited presently at the *Museu Nacional Arqueològic de Tarragona*, but it is possible that it also served Alejandro Ferrant to project reconstructions of the tiers trying to mimic the original structures of the amphitheatre.

As mentioned above, the abundant reproductions devoted to the Amphitheatre of Tarragona exemplify the evolution of representation techniques over the past five centuries. And if we go beyond the technical capabilities, we can identify the objectives that led to the necessary to register graphically the reality of the architectural complex at a particular moment; these objectives are the manifestation of the obsessions and sensitivities of the different periods, even though, in many occasions, circumstances forced the artists not to strictly adhere to the commission, or coincidences led to an unexpected utilization of their work.

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Putting the Colour Back into the *Rua Junqueira* in Lisbon

Ángela García Codoñer, Isabel Braz de Oliveira, Ana Torres Barchino, Juan Serra Lluch and Jorge Llopis Verdú

Abstract The aim of the present article is to explain the objectives, methodology and approval of a coordinated European Research Project leaded by the "Territory, Architectural and Design Research Centre" (CITAD) of the "Minerva Foundation, Culture, Education and Scientific Research" (FMCEIC) in Lisbon, together with the "Grupo de Investigación del Color" (GIC) del Instituto Universitario de Restauraciónm del Patrimonio (IRP). This project, entitled "Methodology for the development of a Color Plan in a Urban Environment" was founded by the "Technology and Science Foundation" (FCT). This project has lasted for three years and has been carried out by a multidisciplinary team of lecturers, doctors and professionals specialized in Colour in Architectural Heritage.

Keywords Color recovery · European research · Rua junqueira

1 European Context

The R&D plans for scientific development in recent years have undergone major expansion, moving from a national to a European scope, creating the essential cross-border synergies that create an important area of research, technology

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development and innovation between different countries and groups of professionals, favouring scientific growth in our society.

International research projects, therefore, are being set up in the globalised world in response to advances in knowledge that demand a greater degree of understanding of socio-cultural diversity. International projects use an interdisciplinary approach that incorporates different groups of researchers and brings together a combination of analytical perspectives that are particular to each region.

The opportunities for international R&D collaboration in both national and particularly international projects provide access to a wide range of European programmes with the creation of International Commissions as a way to access, develop and explore consciousness for the benefit of mainstreaming, which hugely benefits R&D.

2 Technology and Science Foundation, of the Portuguese Ministry of Education and Science

The FCT, or *Technology and Science Foundation,* under the auspices of the Portuguese Ministry of Education and Science, is the Portuguese national agency for technology development and R&D. The FCT provides support to the scientific community in Portugal through a series of different funding instruments that are geared towards scientists, research teams, as well as R&D centres. With these instruments, the FCT provides support for advanced training, developing research, the development of research infrastructures and access thereof, as well as promoting international networks and collaborations, in addition to scientific conferences and communications.

Our Colour & Heritage Research Group at the Polytechnic University of Valencia, together with the *Lab- oratorio da Cor (Colour Lab)* at the Lusíada University in Lisbon initially presented a joint project to restore a wonderfully singular street in the city of Lisbon.

The FCT, through a call for tender for R&D projects, approved, together with the necessary funding, the European Project entitled "Methodology for the development of a Colour Plan in a Urban Environment" for the *Rua de Junqueira,* an emblematic and historic street in Lisbon. The project was to be administered by the Minerva Foundation, for Culture, Education and Scientific Research (FMCEIC) in Portugal, as the Portuguese contingent, through the Territory, Architectural and Design Research Centre (CITAD). The representative body for Spain was to be the Heritage Research Institute and the Technology Transfer Centre (CTT) of the Polytechnic University of Valencia. The research group was to be formed by two teams, one Portuguese, one Spanish, with Angela Garcia the lead researcher. The organizational structure was to be coordinated by Professor Isabel Braz de Oliveira and Professor Angela García Codoñer. The researches from both groups comprised the following doctorate-holding lecturers: Ana Torres, Juan Serra, Jorge Llopis, Pablo Navarro, Hugo Barros da Rocha, Irene de la Torre, Salvador Gilabert and Aitziber Irisarri. The Coordinator of the Portuguese team, María Braz de Oliveira and her research team from the *Lusíada University of Lisbon* comprising the following doctorate-holding lecturers: Nuno Ludovice and Joaquim Marcelino da Conceiçao.

3 The European Project: The Case of Portugal, "Methodology for the Development of a Colour Plan in an Urban Environment"

Presently, *Rua da Junqueira*, in Lisbon (Fig. 1), comprises an urban area of great wealth; the formation and the evolution of this urban hub goes hand in hand with that of the Tajo River, with the growing occupation of the river bank of its extensive river beach, which due to its prime location, was used as a port area in its earliest settlements with an important strategic position in the defence and control of the entry of boats and ships into the Port of Tajo.

Currently, the linear morphology of this urban hub is characterised by its architectural and orographic heterogeneity with the multiple typological, formal and aesthetic languages of its buildings, that reflect the different periods of its past, and at the same time express a dynamic dialect between the ways of life that developed over the years and reflected in the buildings. As mentioned by historian Nuno Ludovice, Rua Junqueira "constitutes a privileged universe from which to identify the coexistence of models and processes that over its long historical evolution has managed to maintain its urban history, whose artistic qualities and varied heritage are strongly identified with this zone" (García and Oliveira 2014) (Fig. 2).

The chromatic aspect is just as important in the spatial reality of this street, and is a structuring element of the cultural and urban identity expressed in a heterogeneous world of different architectural types, as well as the rich chromatic diversity of its buildings.

This urban hub has undergone a series of major transformations from the dockland area of the Tajo with its industrial design, to the construction of residential areas, and with the advent of the gentrification and the arrival of the bourgeoisie and nobility, their palatial homes and mansions.

This *cohabitation* of a wide variety of architectural styles is a major challenge for us, the job of recovering the colours of this array of architectural types from a historical perspective and the coordination of these assets that are part of the same street was a very interesting professional challenge for both teams.

Fig. 1 Developmental readings of the area around the Cordoarioa National (18th–21st centuries) and an aerial view of *Rua da Junqueira* in its present state (CML)

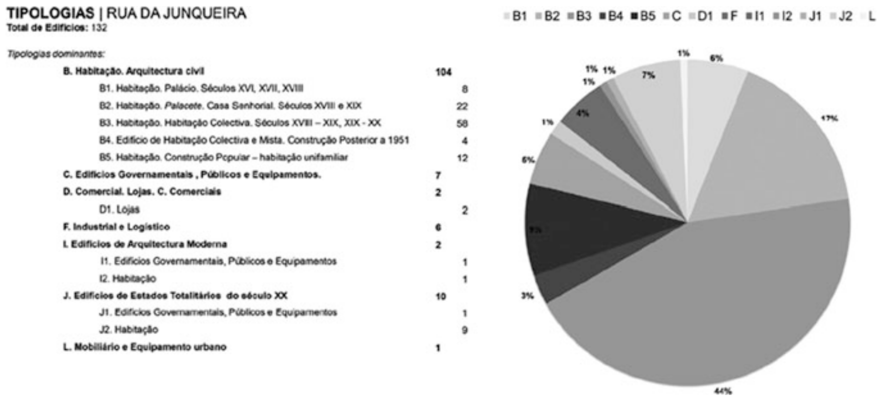

Fig. 2 Summary of the architectural typology of *Rua Junqueira*

4 Strategy employed in the development of the research

Work began with an approximation of the subject of study, analytical systems developed for each specific case, based on an "understanding of the city, or parts of the city, resulting from the material, cultural and socio-economic processes that built it from a spatial and temporal perspective and from the experience (…). The concept of Historic Urban Landscape helps to tie together the tangible and intangible elements of architectural heritage in order to evaluate and understand the city or urban space as a process and not as an object" (Van Oers 2010). Consequently, a study methodology was developed based on evaluation worksheets, one for each specific building, which enabled us to build a simplified description of each of the different architectural types, and these can be continually amended as the minor details are added to each of them. Below is a description of the new strategies used in this particular project, the common denominator being the preparing of the aforementioned analysis worksheets specific to each area of study.

- *Worksheet Type 1. Architectural Type* (Fig. 3): An analytical study is required on the architectural type to be able to tackle, using architectural language, the construction systems themselves, which reflect the technology and the aesthetic tendencies from a particular historic moment in time. Its typological understanding provides us with a more comprehensive knowledge about the overall composition of the urban sector under study. The systematization is essential to be able to establish the grouping criteria and to tackle therefore the organization of future chromatic interventions; a typology study allows us to classify the structures, based on the definition of the worksheets created for that very purpose.

The sheet contains the architectural type with a scaled graphic elevation that depicts each and every one of the details on the façade of the construction. This comprehensive description highlights all the structural, functional and ornamental elements of the buildings. In this way, one is able to elaborate the necessary study

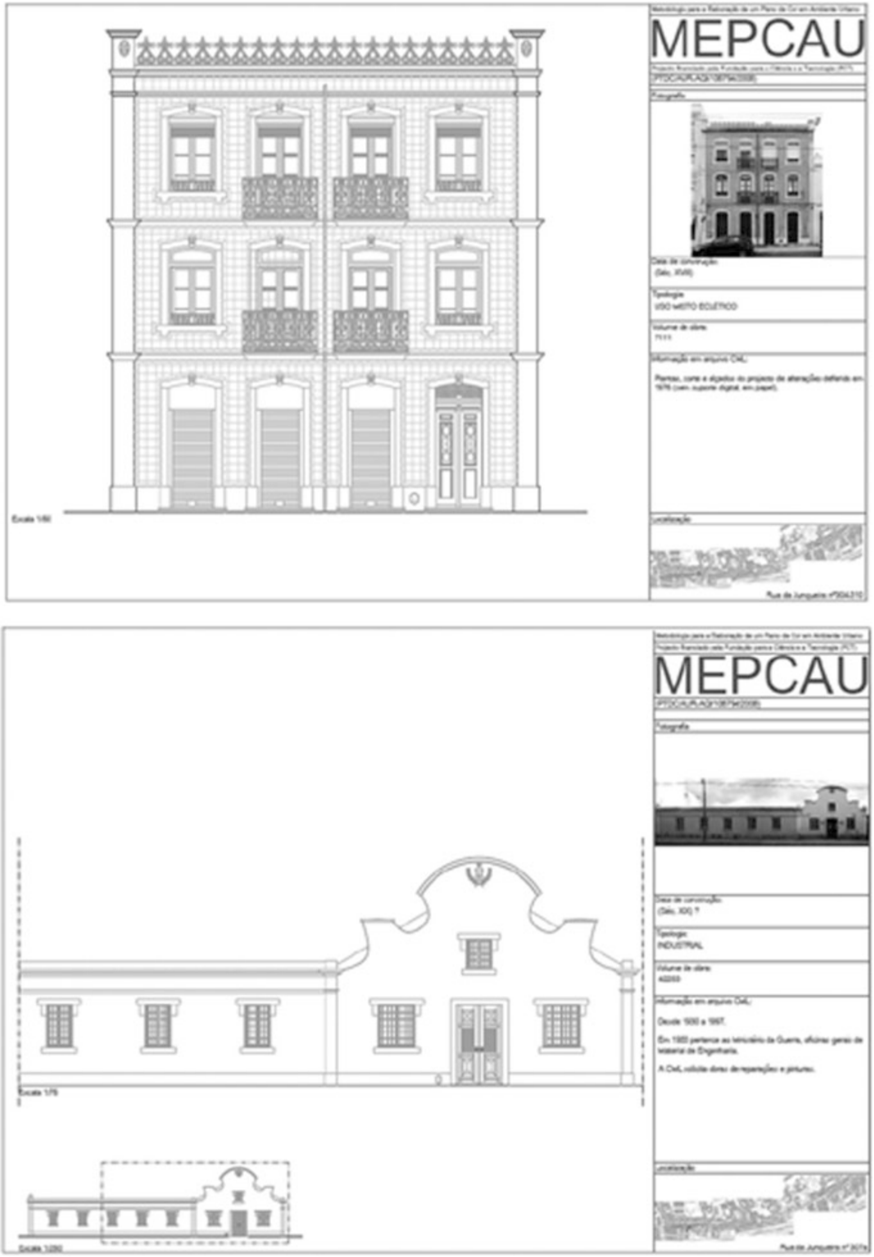

Fig. 3 Two case studies of architectural typology. Typical 19th century dwelling. *Palacete* (Mansion) 1760

about the carpentry and metalwork, ornaments, and any other elements that characterize the composition and the aesthetics of the façade.

With this description, any formal changes or *a posteriori* interventions should there be any, can be traced. It also indicates the location and the placement of the structure as well as the urban shell of *Rua Junquera*.

- *Worksheet Type 2. Analysis of the samples taken from the façades of Rua Junqueira using instrumentation techniques* (Fig. 4): They also contain a description of finishes and plastering of the façades together with samples taken from the finishes themselves, and the analytical process used to obtain the results that are conducive to the elaboration of the Colour Chart. The sheet contains each reference and its description, together with identity and technical analysis used for its characterization, such as the morphological characterization by means of Optical Microscopy and the chemical and mineralogical characterization.
- *Worksheet Type 3. Ceramics in construction* (Fig. 5): Portuguese tiling is one of the characteristic assets of its architectural heritage. Used from the 16th century up to the present day, its origins go back to the Islamic ceramics found across the whole of the Iberian Peninsula and might be considered to be one of the major legacies of decorative art of any of the Mediterranean countries.

Carrying out a comprehensive survey of the buildings along the *Rua Junqueira*, approximately a third of the total of 126 façades are found to be tile-covered. The colour palette that is surmised following an analysis of the current ceramics along the *Rua Junqueira*, is extensive. The use of tiles to create colour schemes, glosses and relieves on the surface of the façades was also examined, resulting in an urban space that boasts many tonalities and a chromatic dynamism according to the type of architecture. Among other things, the worksheets also contain the ornamental design of the façades as well as its composition and colorimetric assessment using techniques that are adapted to this specific purpose for every colour of each individual tile. These are then recorded and can be used for any future analysis or restoration projects.

This graphical material expresses to a large extent the use of a new analysis strategy, to manage the classification and the detailed study of a complex urban area. The clear order that is obtained by way of the graphic description is interesting, and can even be used for the analysis and elaboration of a study of a single building.

5 Results

The project has highlighted the rich heritage significance of the *Rua da Junqueira* by examining the historical colouring of its buildings and the recovery of its cultural heritage, a process that connects it to its past, but far from being in the past, should be recovered for the benefit of our present. The research findings are available to local townspeople in a book entitled “Cor da rua da Junqueira”—The Colour of Rua

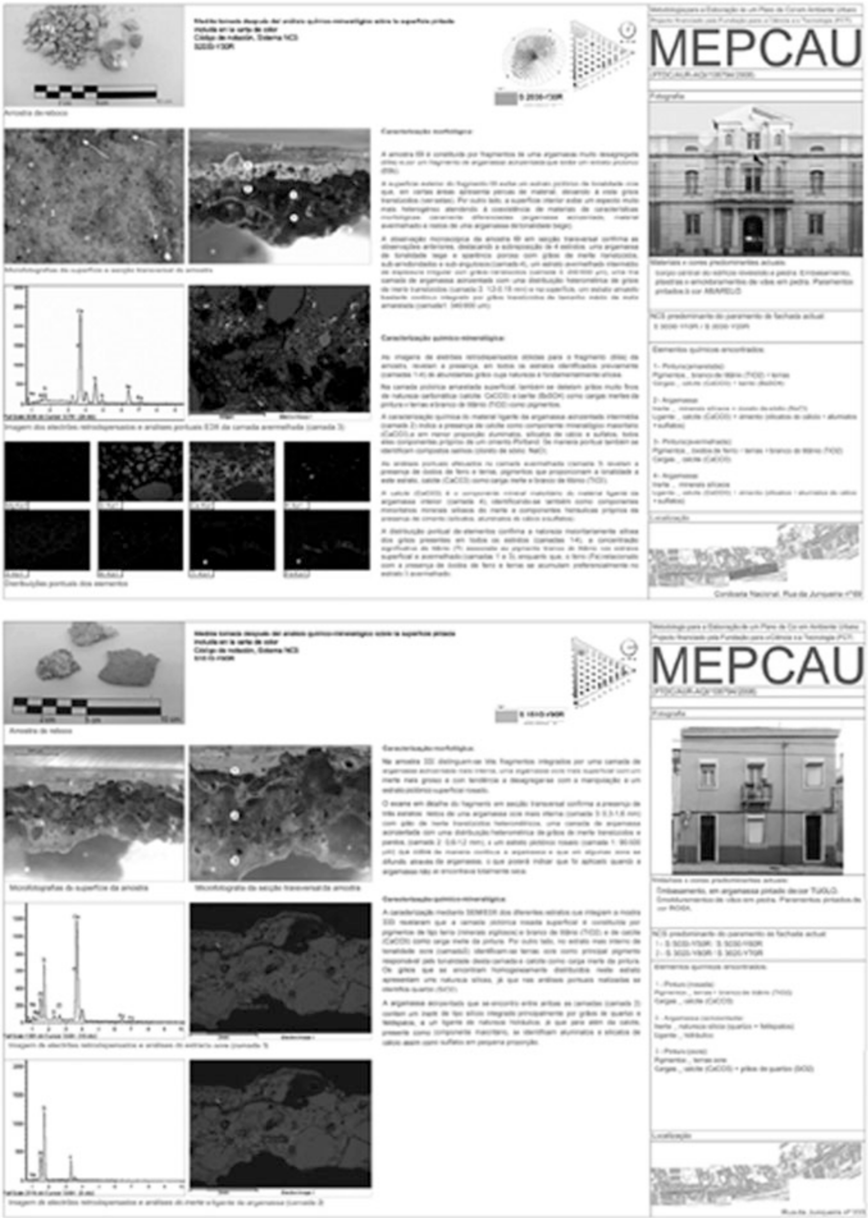

Fig. 4 Two case studies carried out on buildings in the *Rua Junqueira*

Junqueira (Fig. 6), which contains information, both about the procedures used and the results of the study for each of the architectural types and its historical provenance (down to a particular period), or ownership, giving rise to a recovery process of the Urban History of this very unique area.

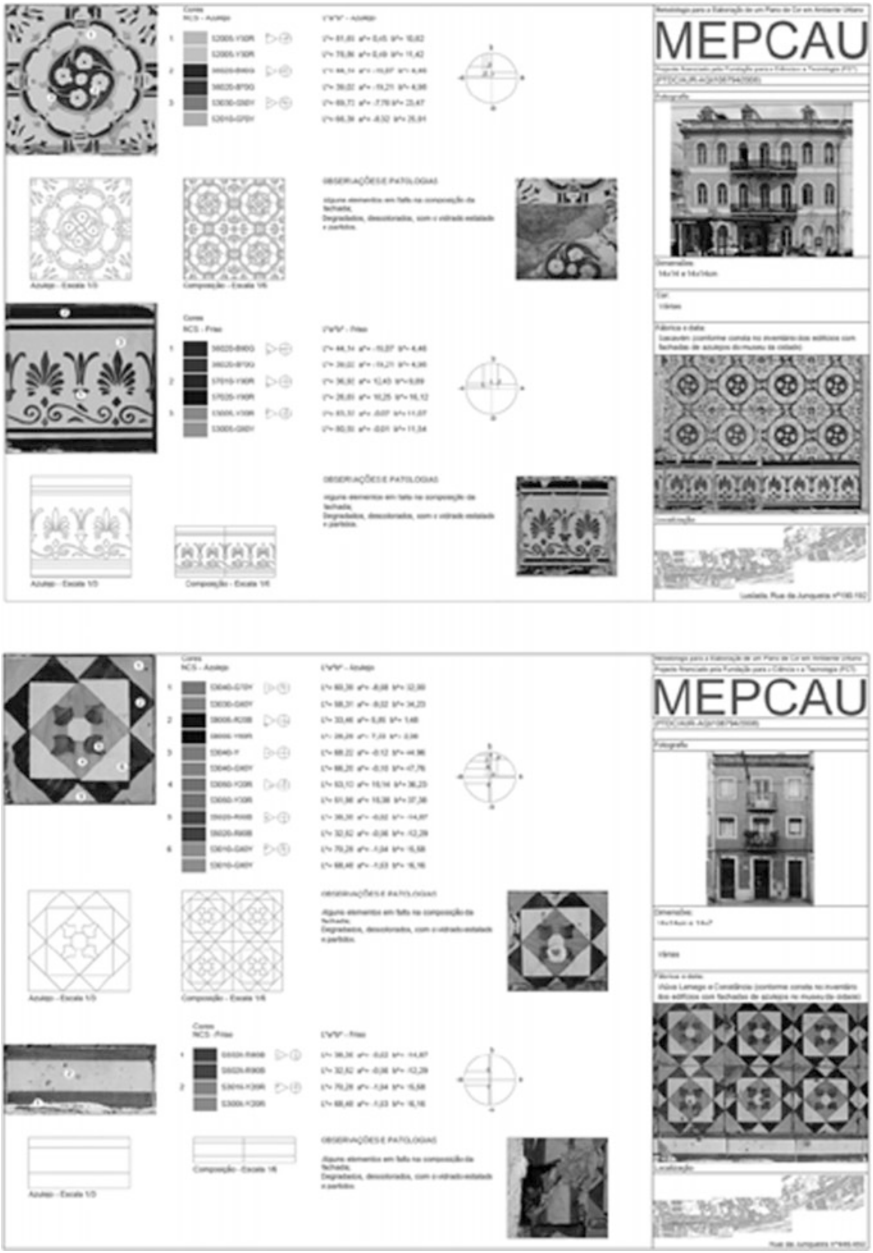

Fig. 5 Two ceramic case studies in the Rua Junqueira with the rich ornamentation of their façades

Fig. 6 "Cor da rua da Junqueira"—The Colour of Rua Junqueira–, which was published following the project

The book provides a very useful tool for cultural heritage recovery from the personal perspective of the local inhabitants. The publication includes a CD-ROM that is compatible with personal computers providing access to the typology worksheets and the corresponding study for each and every one of the buildings that are part of the *Rua da Junqueira*. Its purpose is that of a practical manual aimed at local citizens, with which they can easily and effortlessly access the records for each building, and can browse how best to carry out any intervention, in the interest of recovering the historic urban landscape of this very particular street in Lisbon, encouraging as such its preservation. And the web page (www.ruadajunqueira.wordpress.com) that was created is used to disseminate information over the Internet about the processes used and the results of the study and where, like both the book and the CD-ROM, the neighbours of the *Rua da Junqueira* are able to receive clear and concise information about how to tackle a restoration project of their own building using the analysis worksheets that contain comprehensive data about the composition of the external parameters and the Colour Chart generated as part of the study. In this way, anyone, whether it be a researcher or a neighbour from Rua itself, can freely, in an easy and user friendly way access the data. As for the final dissemination channel, it should be noted that the whole of this research project, the study and the results, both scientific and professional, have been presented at important scientific forums, at a number of different scientific congresses and seminars, both nationally internationally.

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Representation of the Construction of the Modernist Movement in Valencia. Series of Photographs by the Sanchís and Desfilis Photographic Studios

Javier Cortina Maruenda, Pedro Molina-Siles, Hugo Rocha Barros and Salvador Gilabert Sanz

Abstract Since its inception, photography has been a wonderful ally for architects. The union between the two disciplines has survived until today. Photography has acted either as a disseminator of works by architects, or has used architecture as a backdrop for its reporting. Moreover photography can be considered to be a tool to educate the eye of the architect and refined in a manner that is equivalent to that of drawing.

Keywords Photography · Modernism · Valencia

Since its inception, photography has been a wonderful ally for architects. And this perfect partnership between both disciplines has continued through to the present day. Whether it be as a mere disseminator of their work for the architect, or as a backdrop to provide a greater impact for a report for the photographer, the relationship has gradually evolved, transforming the prominence of the objects being represented, and as such, its actors.

Photography should not simply be seen as a means of disseminating architectural and photographic propaganda, but rather as a valuable analysis and training tool for

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the eye. For both established and budding architects, it makes a perfect tool for reflecting about architecture and as a means of expression.[1]

One of the advocates of photography as a valuable asset in the education of architects is without doubt Helio Piñón. His book *Project Theory* (Teoría del Proyecto in Spanish), published by ETSAB, clearly reflects his attitude to this matter, as he eulogizes the visual perspective of architecture and how photography can help to refine it.[2]

To quote him *verbatim*, and with the clarity of expression he is renowned for, he states that: "Only the consensual insolvency of architectural study programmes over the course of the past forty years can explain why drawing and design—in all of its methods and techniques—appears as a separate subject to the architectural project, with photography excluded from its core subjects altogether. A photograph, not only construed as an instrument to visually represent architectural reality, but also as a building tool, in other words, as a design tool and a tool to describe new visual realities—that is to say, both different and consistent through the use of the structuring dimension of the gaze". *Graphic Representation of the building and the visual construction of architecture.* It is therefore a technique that educates the eye and refines one's contemplative thoughts.

Having succinctly argued the importance of photography in architecture, and even positioning it within graphic expression through drawing, as so succinctly expressed by University Professor of Architectural Projects, Helio Piñón, by pairing them together in the extract from the article quoted above, it might be useful to review two of the references to the modernist movement in Valencia.

It is widely accepted that the start of architectural modernism began with the bursting onto the scene of the avant-garde movements of the 20th century, with perhaps DOCOMOMO (the International Committee for the Documentation and Conservation of Monuments and Sites of the Modern Movement) being the most prestigious entity to attests to the quality of the work. DOCOMOMO therefore established a two-fold quality criteria for architectural works, starting at the onset of the Modern Movement, marking both a start and end date, 1925 and 1965, respectively.

But within this historical timeframe, it could be said that Valencia was a "later starter" when it came to modernity. This said, significant architectural works did appear in Valencia towards the latter stages of the modernist movement.[3]

Photography, on the other hand, did not take long to get a foothold in Valencia in the early part of the 20th century. It should be remembered that Valencia at that

[1]To quote two examples, the Madrid School of Architecture is contemplating two optional subjects that include photography in its Department of Composition, while the Barcelona School of Architecture is thinking of making photographic competency part of the learning goals for a number of its subjects.

[2]*Teoría del Proyecto*. Ediciones UPC, 2006. Also see the interesting article *Representación Gráfica del edificio y construcción visual de la arquitectura.*

[3]The list of buildings considered to be of interest by the DOCOMOMO can be browsed at the following site, http://docomomoiberico.com/index.php?lang=es.

time boasted a major commercial port and was therefore the gateway to new inventions and discoveries. The very first camera to be built in Spain was manufactured in Valencia, and Valencia was also the site of the first photograph to be taken using the *daguerreotype* process.[4]

Nevertheless, the early appearance of photography in Valencia did not extend to architectural photography, and even less so to architectural photography of the Modern Movement. Consequently, not many of the quality Valencia photographers managed to make a name for themselves nationally. In fact, it was not until Finezas, with his legendary photographs of the Juan Haro Piñar Service Station in Oliva (1960) that we see one of the few photographers to have broken through the local ranks to enjoy a certain national renown.

In addition to Finezas, a considerable number of top quality photographers were also working in the Valencia Region. Of particular note are the photographic studios of Desfilis and Foto Studio Sanchis. A large part of their photographic collection can be found in public archives.

Although specialising in very different fi a large part of the work of both studios was dedicated to architecture.

Defilis was primarily commissioned to photograph completed buildings. For this type of project, a certain rapport must exist between the eye of the photographer and that of the architect. Photography as such is an abstraction of reality, interpreting, simplifying the experience of space. With such a simplification, it should be the photographer, with their technical expertise, who showcases the features that the architect has integrated into their work.

Below are images of 2 projects photographed by Desfilis.

The first dates from the start of Modern Movement, and is the former Valencia Royal Marina &Yacht Club designed by Goerlich and Fungairiño, (1932–1935). The image contains boat-like forms that were precursors to modernity. Forms with sweeping curves that are a reminder of the form of the ships from that period, with railings and balconies of a similar ilk. In this photo, this concept is further accentuated with the introduction of the pergola into the frame to create a powerful, curved line that virtually ties in with that of the building itself. The pergola, key element of the photo, creates a very strong foreground, which adds depth to the scene. Furthermore, tying in nicely with the theories of György Kepes about dynamic equilibrium,[5] and which husband and wife team, Moholy-Nagy, would speedily apply to their photographs from the Bauhaus school, the pergola brings with it an unusual sense of movement and dynamism to the scene for the period in which it was taken (Figs. 1, 2 and 3).

The second of the images focuses on the relationship between the building and the sea. In this example, the aim is that the constructed components do not take form, but that the swimming pool does. The strategic position of the photographer,

[4]See AAVV "Historia de la fotografía Valenciana" published in the "El Levante" newspaper. The first photograph is attributed to Valencian dentist, Juan José Vilar.

[5]See *Language of vision*. Published by Paul Theobald and Company, 1944.

Figs. 1 and 2 Desfilis. Valencia Royal Marina & Yacht Club. 1935. Architects. Francisco Javier Goerlich Lleó and Alfonso Fungairiño Nebot. Nicolau Primtiu Valencian Library, Desfilis Fonds raised above the ground plain, in addition to the uniform lighting of the swimming pool, enables them to create a sense of continuity between the water of the swimming pool and that of the sea. The perspective is an essential element as it adds a static quality to the scene so that the rapport between the sea and the swimming pool becomes the focus.

Another wonderful example of the work by Desfilis and one with an intense focus, was the Faculty of Law by Moreno Barbera.

In these photographs, the architectural project that appears uses a consolidated, modern language. Both images take the volume of the classrooms as the main subject, which stand there, compensating for the flatness of the approach that accompanies it. In one of them, in order to increase the sense of depth, natural elements appear in the foreground. Both pictures contain diagonal lines that accentuate the composition. Thus the path and the volume that protects us as we make our way to the entrance play a double role (Fig. 4).

We next focus on the Sanchís photographic studio, and like Desfilis, is a family dynasty from Valencia that boasts a long line of photographers. As far as architectural photography is concerned, the professional approach of Sanchis differs from that of Desfilis. For the majority of its photographic coverage, Sanchís, tracks the actual construction of the main buildings from the Valencia age of modernity, motivated in most likelihood, by the requisites of the client brief. Of particular note among its numerous photographic reports are its unparalleled images of the construction of the Guadalaviar School. The school, architecturally disfigured nowadays one might say, was designed by architect, Fernando Martínez García-Ordóñez. Undoubtedly one of the added benefits of architectural photography is being able to get back to the original features of the construction, which will have been either altered, or destroyed. In this particular case, the client brief related to a small convent school with classrooms for both infant and primary school. The site was in the shape of a triangle, nestled between residential dwellings and the former railway line to Saragossa. The project contemplated four small solitary pavilions within a garden area with infant school classrooms and a building, which like a double bridge, forms a courtyard to receive the students (Figs. 5, 6 and 7).

In this series of photographs, the photographer, most likely at the request of the builder, carried out a graphic journal of the construction. In the first two images, we can make out the light metal structure of the vertical element of the administration building that little by little begins to take shape. It is interesting to note how the photographer decided from the onset of the project the perspectives that remained the same throughout the whole construction process.

The final image shows the building upon completion, clearly reflecting the relationship between the horizontal element, a bridge for one part, which houses some of the classrooms, and the vertical element, used for administration purposes.

In the three images, there is a strong diagonal component that creates both depth and dynamism. In the last one, forced by the departure of the bridge element, which offsets the path that appears to the right of the image. Elements such as the contrast between natural and artificial, or the use of elements in the foreground are recurring compositional strategies. With regard to the lighting, the only conclusion we can

Figs. 3 and 4 Desfilis. Faculty of Law 1956. Architect. Fernando Moreno Barbera. Nicolau Primtiu Valencia Library, Desfilis Fonds

Figs. 5–7 Sanchís. Guadalaviar School 1958. Architects. Fernando Martínez García-Ordóñez. Graphic Archives of the Department of Education, Culture and Sport. “Foto Sanchis”

come to is that this was done intentionally for the photograph of the completed building, given that the others are executed using a more casual approach. Thus, this photo displays the functional use as a sun blind and the justification for the flight of the shelter provided by the classrooms of the bridge element.

The last series of images (Figs. 8, 9 and 10) are taken of the German College of Valencia (1961), designed by Pablo Navarro and Julio Trullenque. This school concentrates all of its academic operations in a single prismatic component, a ground floor plus four upper floors. The ground floor component is connected to the infant school pavilion and the gymnasium by way of a pergola that determines the circulation. The more emphatic volume that that of the previous example gives a sense of full and empty spaces along the main façade. This volume is quite distinctly raised above the ground on pilings, in keeping with the principles of the Modern Movement.

The selected images show a moment in the construction process that coincides with that of the following image. This explains how, from the very start, the photographer selects the viewpoint based on what he wants to narrate about the project. It is a view of the classroom component from within the courtyard. In this particular case, the construction comprises a conventional structure on pillars using reinforced concrete, and does not have the lightness of the earlier example. Quite the contrary, the construction becomes rugged, with the solid presence of the nucleus, which can be observed to the left.

The third image positions the spectator beneath the connecting pergola. This sheltered and shaded viewpoint strengthens the sensation of inclusion by the observer within the two-dimensional space of the photograph. Similarly, clearly visible is the transparency of the ground floor, the vocation of this covered walkway to link the whole building. There are no elements in the image that interrupt the view along the passageway. It highlights the natural and artistic components of the school, with a very much different character to the former one.

In conclusion, what is certain is that these photographs exemplify the main features of the architecture that they represent. Furthermore, they enable us to discern the architecture and moving past the architectural object itself, they introduce the artistic components of modernity that can be extrapolated to the creative process of any project that is part of the Modern Movement.

The use of photography in the teaching of a discipline such as architecture is therefore necessary in the training of any future architect. Accordingly, by studying these images by Valencia photographers, perfectly ties together the refl of architectural photography with those of architectural concepts, validating per se the approach that architects need to learn this discipline.

It could also be said that intelligent photography, namely that which draws attention to the architectural features of a building, implies training the eye, knowing how to look at and consider why decisions in a project are made. Just as the drawing of architecture forces one to mentally construct the features of a planned project, photography, understood in the way, requires a similar exercise. Whether it ignites emotions is a matter for artists.

Figs. 8–10 Sanchís. The German School 1958. Architects. Pablo Navarro Alvargonzález, Julio Trullenque Sanjuán, Dieter Weise, Peter Müller. Graphic Archives of the Department of Education, Culture and Sport. “Foto Sanchis”

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Architectural Interventions by Rafael Manzano at the Real Alcázar of Seville. 1966–1988

Julia Manzano Pérez de Guzmán, Pedro Barrero Ortega and Rafael Manzano Martos

Abstract More than twenty years of interventions at the palatial set the Real Alcazar of Seville, mostly developed in the position of Director-Conservator (1970, 1988), makes Rafael Manzano Martos the architect who sets the current appearance of much of its interior spaces. A complete tour is proposed in those places where he made his mark, such as: *Patio del Príncipe, Patio del Asistente, Patio de Levíes, Casa de Contratación, Patio del Tenis, Patio del Sol, Patio del Extremo Norte del Crucero, Patio del Yeso and Sala de la Justicia, Palacio Gótico and Palacio del Rey Don Pedro.*

Keywords Rafael Manzano · Architectural restorations · Alcazar of seville · Architectural drawing

1 Introduction

Rafael Manzano Martos, born in Cádiz in 1936, was granted the degree in architecture by the Superior Technical School of Architecture of Madrid in 1961. Since 1968, and for more than forty years, he has been teaching as a tenured full professor of History of Architecture and Urbanism, Theory and Techniques in the Restoration of Monuments at the Superior Technical School of Architecture of Seville, of which he was Dean from 1974 to 1978. As a Permanent Academician of the Real Academia de Bellas Artes de San Fernando in Madrid, in 1972 he received the Gold Medal for Merit in Spanish Fine Arts. In 2010 he received in Chicago the

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Richard H. Driehaus Prize, given annually since 2003 at the University of Notre Dame (Indiana, USA), for his ability to apply the classic ideals to the local vernacular architecture; his capability to combine many cultural influences on an end product which is firm and has an identity; his respect for the past and his legacy to the future. Following this award, considered one of the most important in the world to a professional career in the traditional architecture, since 2012 the Rafael Manzano Martos Classical Architecture and Restoration of Monuments Prize is being launched in Spain, sponsored by The Richard H. Driehaus Charitable Lead Trust, with the support of the Mapfre Foundation, the Real Academia de Bellas Artes de San Fernando and the School of Architecture at the University of Notre Dame.

Gifted with an extraordinary aptitude for drawing, Manzano has based his practice and his teaching in a skillful and intelligent use thereof (Gámiz 2013), with the additional intention of poetically expressing the beauty of this architecture.

Rafael Manzano took part in the Alcázar of Seville for two periods: from 1966, under the direction of his predecessor, the director Joaquin Romero Murube (Ybarra 2003), and after the poet's death from 1969 to 1988 on his own. This paper collects and summarizes data on interventions barely known on this fi class monument in Seville, providing in each case the most signifi unpublished photographs, illustrations and drawings documenting and enabling its better understanding.

2 Construction Works Between 1966 and 1969

2.1 The Prince's Courtyard (Patio del Príncipe)

In Romero Murube's times, there was a budgetary provision at the Alcázar, funded thanks to the sale to the City of Seville of a strip of land belonging to the Alcazar, adjoining the rear of the houses along the whole of San Fernando Street in order to enlarge those houses, giving them greater depth and making them more comfortable and profitable. Fernando Fuertes de Villavicencio, in charge of the National Heritage at that time, decided that the money would be allocated to urgent and necessary construction works at the Alcázar.

One of these construction works was at the Prince's Courtyard, known at that time as The Kitchens' Courtyard, because one of its fronts was occupied by the kitchens. The access to these kitchens was through the oratory of the Catholic Monarchs, whose chapel had also been restored on that occasion. An oblique corridor with a squinch was designed, and at the courtyard's blind facade the columns of the building by Vermondo Resta were released. This building had a very similar compositional scheme to the Well's Courtyard of the Museum of Fine Arts, designed by Juan de Oviedo y de la Bandera (Marín 1990).

There was also an arcade in that courtyard, which was in part like a sticker, almost in relief on the old wall, a very decayed mud-wall, presumably built in the XII century, of which the thinnest part had been torn down previously for security reasons. This operation saved a great deal of the underground part of the wall forming a crypt which is open for visitors, 2.5 m under the arcade and courtyard floor. Its path and thickness can be seen on the existing pavement. Furthermore the arcade was rebuilt where it had vanished and it was duplicated to create a loggia covered with groined vaults, allowing the sight of the lower gardens with its spectacular tree canopy. All of this was designed with Joaquín Romero Murube's point of view in mind. As an enthusiastic gardener he always had a longing for scenery, rather than valuing the archeological aspects. Here are reproduced the loggia designed by the architect in perspective and floor layout (Fig. 1).

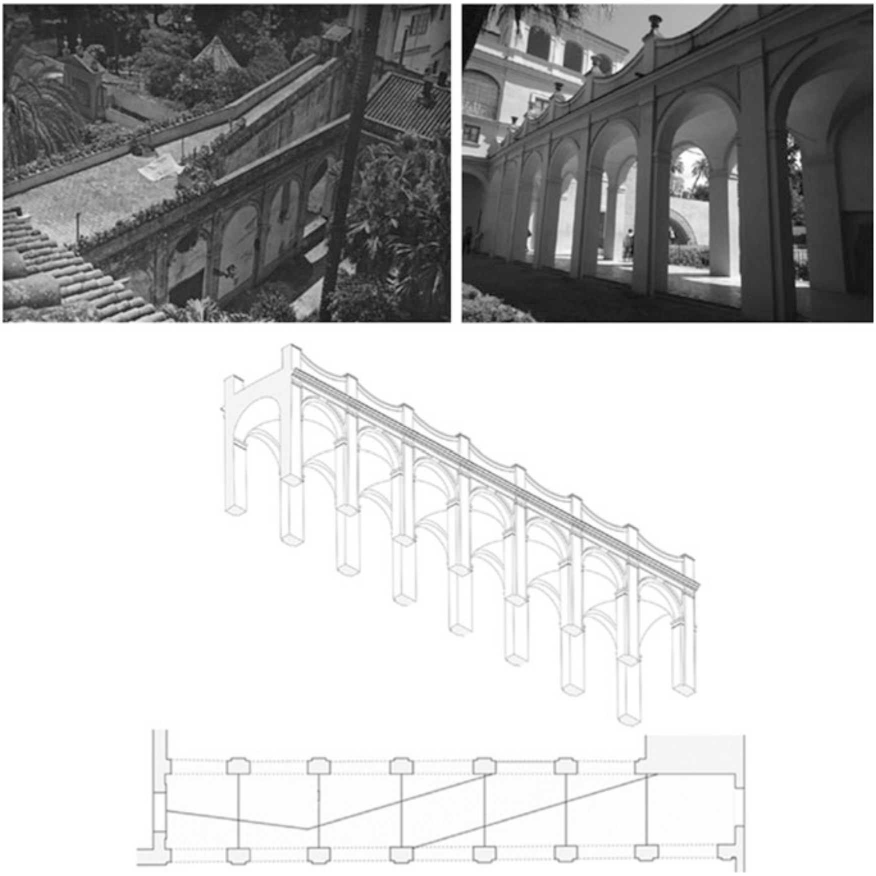

Fig. 1 Old arches on the current wall and loggia

2.2 The Asistente's Courtyard (Patio del Asistente)

This area was known as the Room of the Asistente, who was being housed by the king. The most famous asistente (Seville mayor's aide, equivalent of a king appointed Corregidor in other cities) who lived here (1767–1778) was D. Pablo de Olavide, who had his French inspired enlightened gatherings here, presided by a portrait of Voltaire in the days in which he, as well as Jovellanos were pen friends of the members of the French enlightenment. These construction works were performed under the leadership of Joaquín Romero Murube, and with the aforementioned budgetary provision thanks to the sale of the land strip behind San Fernando Street, where the architects Pablo Arias García and Alberto Balbontín Orta built the current embattled wall that acts as an enclosure for that side of the Alcázar.

During the demolition and disassembly all the elements that were necessary in order to interpret how the courtyard was in the eighteenth century, were showing up. We provide a picture of a penciled drawing Manzano carried out on a stretch of wall, with his theory of philological reconstruction of the courtyard. We also provide pictures of its initial and renovated state. In the aforementioned reconstruction it was chosen to use wooden railings, which are common enclosure at Castilian courtyards of that period, although in Seville, courtyards already had metal railings by that time (Fig. 2).

2.3 The Levíes Courtyard (Patio de los Levíes)

Joaquin Romero Murube and the Monument Commission had authorized the demolition of the House of Levíes, in exchange of keeping the stone arches of a loggia of the building. That gives its name to this current Alcázar courtyard. That loggia, according to Manzano, is attributable to Benvenutto Tortello based on the finesse of their capitals, of such an Italianate style, the breccia marble employed and which is also used in other places such as the House of Pilate, and lastly for its architectural characteristics. The architect Benvenutto Tortello was brought to Spain by the Duke of Alcalá, and authored, among others, the work of adaptation of the ancient fortress of Fontanar to house the palace of the Enríquez de Ribera family in Bornos.

It was possible to draw and reconstruct the loggia with absolute fidelity only thanks to photographs taken for the book "Arquitectura Civil Sevillana", unpublished at the time before its demolition (Fig. 3).

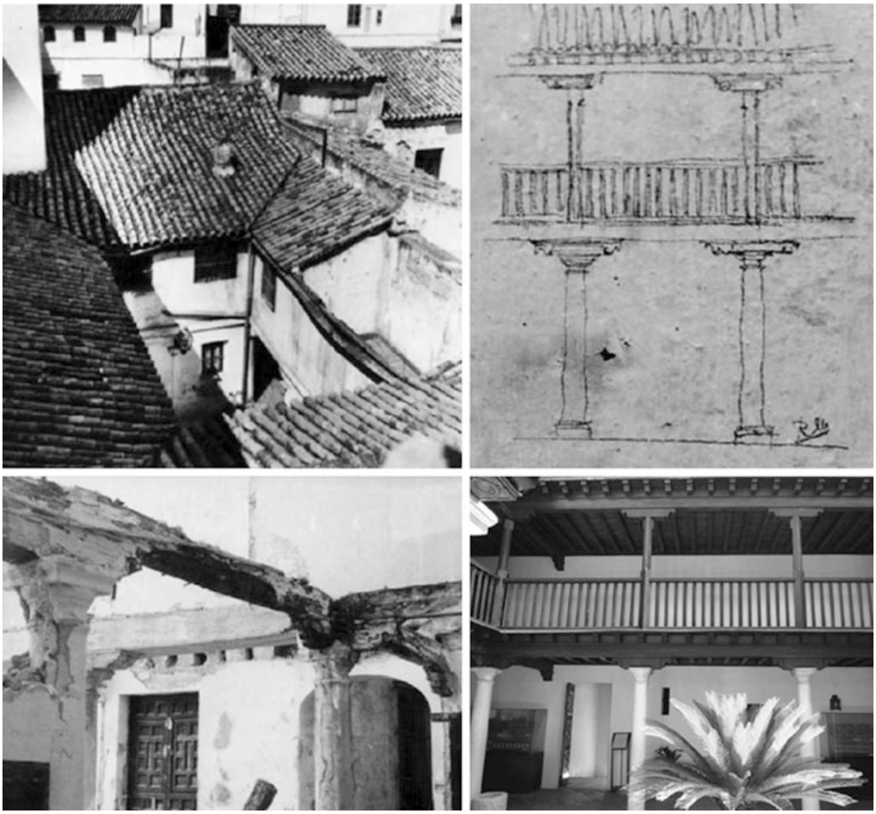

Fig. 2 Photomontage of the initial and renovated states of the Asistente's Courtyard

3 Construction Works Between 1970 and 1988

3.1 House of Contracting(Casa de la Contratación)

A board of heritage and a commission of the Academy of Fine Arts of San Fernando in Madrid headed by its then director, the Marquis de Lozoya, agreed that the old House of Trade lacked any artistic value and its demolition was authorized. This building datable to the XVIII century with a neoclassical courtyard, of apparently little archaeological value—though being one of the best in Seville—had been demolished as early as 1964. It had very academic Ionic columns and at its angles Doric columns which were scattered throughout the Alcázar, at the discretion of its then director, who used them to frame façade gaps saying that "it gave them more authority."

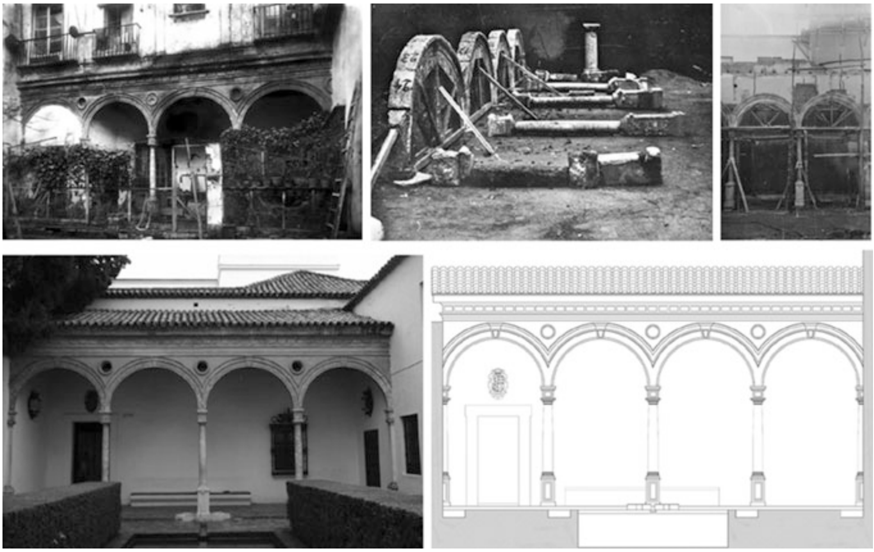

Fig. 3 Loggia of the House of Levíes. Before his disassembly, during assembly and final state

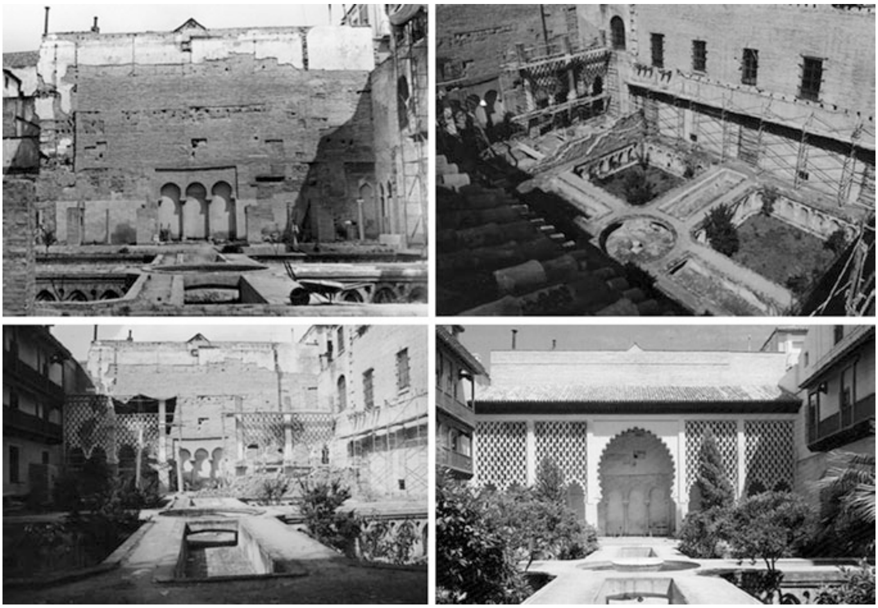

Fig. 4 Photomontage of the reconstruction of the northern front of the *Casa de Contratación*

When the demolition debris from the north side of the courtyard made were left "in situ" for economic disagreements with the contractor, allowing years later found fragments of plaster that could have been preserved if it had made the vertical archaeological exploration of the wall it contained the original Almohad archery. In photomontage prepared for this communication reconstruction was apparent from those archaeological remains.

Ramón Andrada Pfeiffer, predecessor Rafael Manzano at the *Real Academia de Bellas Artes de San Fernando* in Madrid, was for many years his immediate superior in his post as Curator Director of the Alcázar of Seville and Administrator of the National Heritage in this city, because on that aforementioned institution Ramón Andrada occupied successively the posts of chief architect, CEO and manager of that institution (Manzano 1994). There was already a project for the construction of modern housing, by Fernando Barquín y Barón. By Islamic documentary sources, it was known that there had been an Abbadid domestic palace. Ramón Andrada, once contacted, was quick to approve the project drawn up by Manzano, promoted by the Ministry of Housing, and immediately after starting the excavations, the garden with cross paths appeared. The building was completed by Ramon Queiro Filgueira, in its adaptation as Headquarters of the Delegation of the Ministry of Public Works, and Manuel Vigil-Escalera Pacheco completed the northern arcade of this courtyard-garden (Fig. 4).

The current Admiral's Hallwere originally three rooms, which is still apparent in the beam framework, where, at two points, beams are constrained to hug the walls separating this hall.

On the other hand, the painting "*Virgen de Mareantes*" by Alejo Fernández had just returned to the *Alcázar* and its *Casa de la Contratación*, after being held at the General Archive of the Indies for some time. It had to be integrated with the decoration that existed at the *Sala Capitular* (Chapter Hall) of the *Casa de Contratación*, because in their initial restoration the central panel and both side panels had been placed in three very unfortunate separate frames. It was possible to bring a set of gothic crestings that were up on an organ at the *Colegiata de Toro* (Collegiate church of Saint Mary the Great, in Toro), which are now decorating the pictorial set. The architect made the lodge drawings or "drawings on the floor" of that composition on the wall at the end of the gallery of this courtyard at the Alcázar, and if today the layers of lime were removed, his original drawings would still be seen.

3.2 Tennis Courtyard or Alcubilla Courtyard (Patio del Tenis o de la Alcubilla)

An irrelevant incident caused that the Head of State demanded that the City of Seville housed the Curator-Director of the *Alcázar* at the Alcázar, like his predecessors, to permanently maintain an authority in the building. Joaquin Romero

Fig. 5 Front of the Tennis Courtyard. Before and after the intervention

Murube's house was the current exposition hall, the former royal armory where military tools were stored. Because of its excessive height and on some other grounds, it was not appropriate for residential use since it was designed for a different function.

The problem of the residence was resolved at the front of the Tennis Courtyard. There, the excavations uncovered the old foundations of a number of pillars that were reconstructed as illustrated by the photographs attached. In the upper-fl gallery, very uncomplicated, composed of segmental arches, a batch of columns removed from the house number two at the *Patio de Banderas* (Courtyard of the Flags) in the course of the restoration and recovery of its original Almohad courtyard garden. These columns kept some shafts from the Caliphate of Córdoba and also Renaissance capitals manufactured at Aprile di Carona's workshop (Fig. 5).

On the opposite front, the so called *Pabellón de la China* (Pavilion of China) because the ceremonial tableware was kept there, a simple gallery with an arcade on columns that existed in stock and that according to the heraldry of their capitals with bows or scrolls must come from a lost cloister from the Hieronymite monasteries of *Buenavista* or *San Isidoro del Campo*. In the center of the courtyard, an old tennis court of the wardens, a garden was laid out with a sixteenth century fountain recovered from the *Palacio de Sánchez-Dalp in the 1970's*.

The architect recalls that he had gone to draw the Alcázar back in 1950, then aged 14, and was impressed with the counterpoint of light and shadow, especially noticeable at the door to the alley that connects the *Jardín del Chorrón* (Garden of the Jet) and the *Apeadero* (Entrance Hall). Reading Ocnos, he enjoyed a great deal fi out that, a poet like Luis Cernuda was also excited about the miracle of sun and shadow that this space produces. That's the reason he refused to open greater gaps in the wall that separates the alley with the Tennis Courtyard, leaving tall windows and caulking in black all its roof to prevent losing this marvel of contrasts.

3.3 Sun's Courtyard (Patio del Sol)

It is a courtyard from the XIV century, at the reign of Alfonso XI. It is to be noted that the Alcázar has always been treated, in the words of Manzano, as an architectural monument, with respect to its archaeological past, of course, but always ensuring its architectural brilliancy, its outstanding quality.

The eighteenth century's lower gallery of the Sun's Courtyard was already there, although blinded by partitions, and the disappeared gallery from the upper level, once freed from later attachments, was rebuilt, to the best knowledge of the architect.

To illustrate this intervention, a composition of photos and drawings has been provided: a first trial and the final solution of the new upper gallery (Fig. 6).

Another one of the multiple intervened space was the central area of the Alcázar. A house for the doorman and janitor was built there. Also an architectural studio to work on restoration projects and where all the blueprints of the building were kept, as well as other spaces to file the colossal amount of documents that had been stored in a set of cabinets. Those wardrobes came from the closet of Queen Isabel II, reigning at the second half of the XIX century. They were of a very good quality and therefore rising the category of such a transcendent location for historical research as a whole, but impractical at present day for its use.

3.4 Courtyard at the north end of the Patio de Crucero (Patio del extremo norte del Crucero)

Such is the name of the courtyard originated on the northern front of the *Patio del Crucero* that serves as its access. The portal from the Count of Gelves' Palace, which for some time served as a hotel—Hotel Madrid—was placed in a hall where the framework of the stairs of the Convent of Franciscan Conceptionists—al the Menjibar Square in Seville—had been placed on the ceiling. The Alcázar thus became a new monument: the synthesis of all the unique architectural remains of the most beautiful buildings that existed in this city.

In this case photographs and a current drawing of the new design of the façade are the most significant graphic documentation of the intervention (Fig. 7).

During these excavations, at the back of that same hall, an ancient medieval street appeared, which was finished off at one of its sides by the Mudejar plasterwork founded in the basement of a Jerez winery, right in front of the church of *San Juan de los Caballeros at Jeréz*. At the same excavation *neomudéjar* eaves from a demolition showed up.

The *Patio de Crucero* was excavated from underneath, uncovering the lower level gardens according to the two levels described by Rodrigo Caro at the wedding of the emperor.

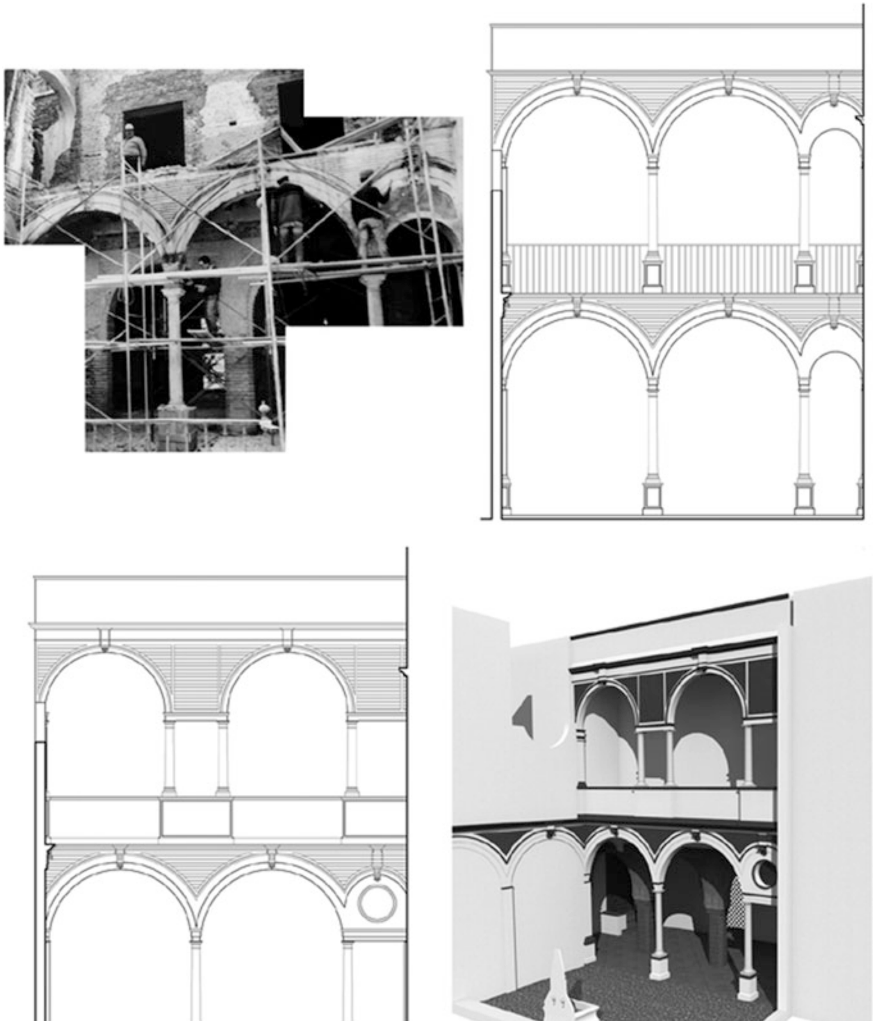

Fig. 6 Gallery Patio del Sol. First trial and definitive solution to the upper floor

3.5 Plaster Courtyard and Hall of Justice (Patio del Yeso y Sala de la Justicia)

The restoration work performed on the Plaster Courtyard by the Marquis *de la Vega-Inclán*, began to detach because of the leaning over of the south facade, so this front had to be tightened and restored, leaving the new materials perfectly

Fig. 7 Western façade of the courtyard at the north end of the *Patio de Crucero* before and after the intervention

Fig. 8 Intervention on the tripartite gate of the north façade of the Plaster Courtyard

characterized. At the restoration of the Marquis, there were aspects which did not meet strict scientific archeological criteria. He had hidden preexisting decorative elements like the tripartite gate of the north façade, from the Almohad period but very close to caliphal models, where he built a much stretched horseshoe arch, in addition to hiding the remains of the upper middle window. This work is illustrated by the attached two photographs of the previous and the end state of the front of the yard (Fig. 8).

In the southern chamber at the Plaster Courtyard there was a wall that divided it in two and thanks to its lack of tas-de-charge, could be saved a stretch of stucco covered high skirting board with Almohad patterns of curved laces.

One of the elements that most attention was paid to was the qubba at the Hall of Justice, or King's Council Chamber, the work of Alfonso XI. Its framework had to be consolidated, a "pineapple" of muqarnas it had been lost had to be replaced, the yamur was rebuilt and its initial slopes were restored. In addition, replacing the glazed tiles, which are larger at the angles, thereby restoring its original volume (Manzano 2003).

3.6 Gothic Palace (Palacio Gótico)

The Gothic Palace had its roofs badly damaged so all vaults had to go through restoration and getting a strengthening hoop attached. The roof lantern of the adjacent room, which was rebuilt in the eighteenth century, after the Lisbon earthquake, had to be restored too, and replaced of the baroque decoration, before the placement of the Flemish tapestries depicting the conquest of Tunisia.

The facade towards the garden was completed, finishing it off with battlements similar to the four corner towers of the castle.

The hall at the interior of the Gothic Palace of*alfonsí* style, had a glazed ceramic fl beautifully designed by *Juan Talavera y Heredia*, which was a copy of a *Mudéjar* pavement which disappeared at the Spanish civil war. The original fl was at the convents of *La Concepción Francisca* and *San Juan de la Penitencia*, both in Toledo, extraordinary monuments of Cisneros style of which Juan Talavera, with a strange historicist sense, had reproduced the model to be placed in this room. It was removed and a more appropriate fl for a baroque hall was placed, reusing *Talavera's neomudéjar* pavement at the *Palacio del Rey Don Pedro*, in places where the original pavement had not been identifi clearly justifying its modern origin.

When the roofs were scraped, the remains of a very distinctive decoration of that time in Seville showed up, and following the same compositional scheme, forming reliefs, the vaulting of this room was given a great vividness.

There is no relevant graphical data on this intervention, of a minor character, although of great interest when you consider the perception of the finishes.

3.7 Palace of the King Peter I (Palacio del Rey Pedro I)

The most apparently substantial feature of the Alcazar, and always has been, was the *Palacio del Rey Don Pedro*. It was the most stable, most formalized and best preserved of the whole architectonic ensemble. This palace had something that it still holds, which is a certain tendency to perfection in its finishings. Ortega y Gasset said that when one comes from the Alhambra and enters the Alcázar of Seville, he suddenly experiences that archeology turns into something comfortable. The Alcázar of Seville has always been a palace that is being used, lived-in, however in the case of the Alhambra in Granada this has not been the case. The Alhambra has also been a very plundered monument in the past centuries, for example Napoleon's troops during the Spanish invasion. The Alcázar, however, became, at the same time, the residential palace of King Jose Bonaparte, so no one here would dare touch or destroy its plasterwork.

At this palace of Mudéjar style there was a façade towards the gardens lacking any palatial character, besides the fact that it was very expensive to maintain. When finally the construction works at the *Palacio del Rey Don Pedro* were undertaken, the interventions started precisely at that façade. The most urgent and important task was to repair the roof.

During the course of the construction works it was feasible and interesting to study how this facade was, since inside it still had, solidly filled in, the gaps of the

Fig. 9 Volumetric cut at ¼ of the qubba of the *Salón de Embajadores*

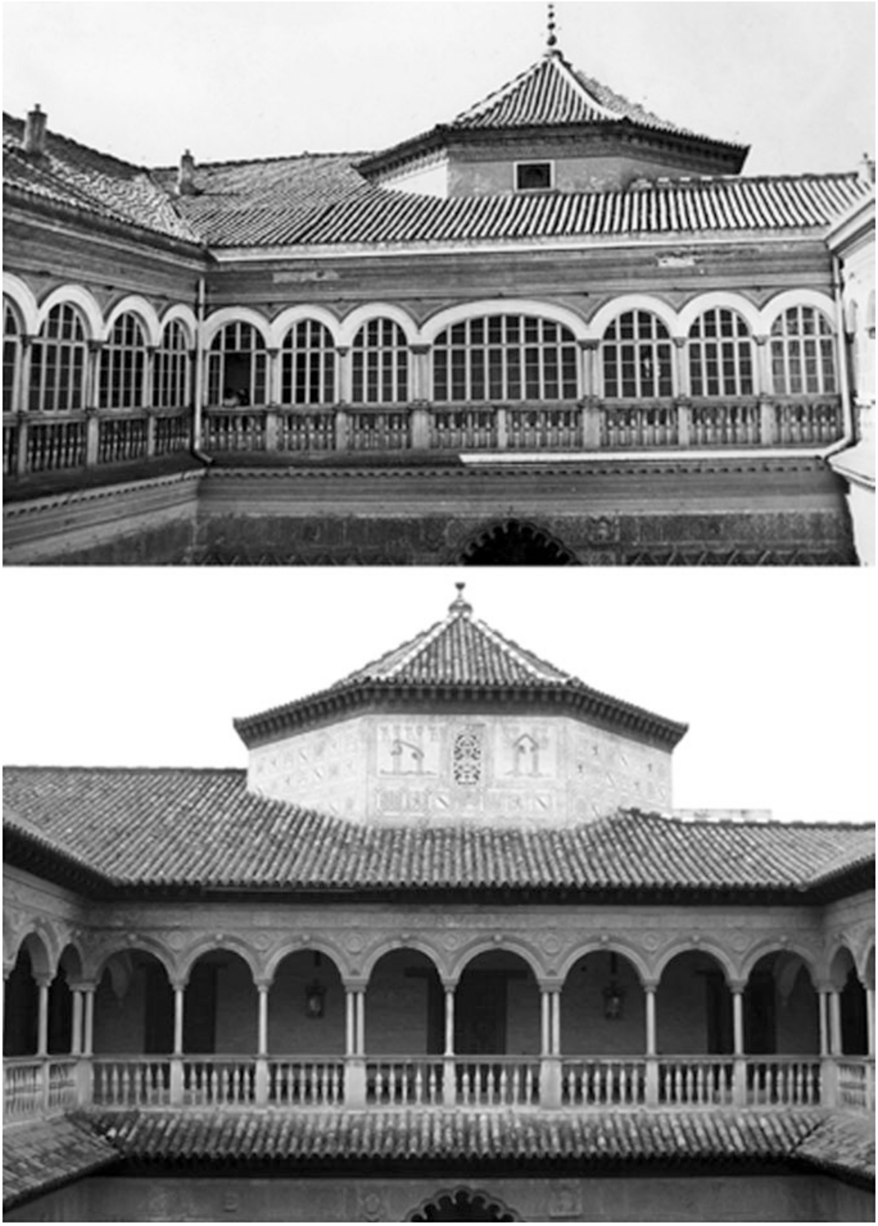

Fig. 10 West façade of the *Patio de las Doncellas* before and after the intervention

bay window then attributed to the Catholic Monarchs, amongst other reasons, because there were a series of ledges with heraldic decoration and decorative shields with bundles of arrows.

At the inside of the *Palacio del Rey Don Pedro*, perhaps the most significant was the intervention at the The Maidens' Courtyard (*Patio de las Doncellas*). During the demolition and dismantling of its *Isabelline Gothic* decorative elements, a painted and carved corbel appeared, so beautifully gilded and decorated, that it served as a model for the design, basic and simplified, of the roof's corbels that presently surmount the ground floor of the courtyard. That corbel has disappeared, and all the efforts to locate it have been in vain.

The corbels of the highest order were made of concrete, for distinction of materials and durability reasons, copying the fragments of the interior decoration still in the gallery.

At some points, the courtyard's roofs "stung" at the skirts of the qubba of the Ambassadors Hall (*Salón de Embajadores*), therefore its elevation was proposed leaving traces of their previous cornices and manufacturing the new ones with molded concrete, painting them in brick dust color to imitate ceramic. To lift the roof of the qubba, a new metal structure was arranged, attaching the existing wooden structure on the inside of the structure and copying, on its exterior walls, the mural paintings, now hidden and preserved under the roof. As an illustration of this complex operation, new perspective drawings have been made to facilitate the constructive understanding of that elevation, and also providing two photographs of the initial and reformed state (Fig. 9).

Finally, the central arches in every front of the upper gallery of the courtyard are modified to reach a monochord rhythm in their arches, restoring, with new stone-masonry work, the needed columns on each of the pedestals of this gallery's stone balustrades (Fig. 10).

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Decision-Making, Sketching, Lasers and Drones. The System for Documenting the Bell Towers in the Province of Burgos

José Ignacio Sánchez Ribera, Juan José Fernández Martín and Jesús San José Alonso

Abstract The "new" technologies we regularly use for teaching are now combined with those enabling data capture of buildings, thus obtaining extremely accurate and liable models. Due to its precision, the virtual model might eventually replace the real structure as study model. Some of the these technologies include three-dimensional laser scanners, digital photogrammetry programmes, or even drones. Thanks to the access to these technological resources (some are free software and most of them are available in the EGA departments), and the skills acquired through graphic training for analyzing and depicting architecture, we obtain a more complete and complex set of documentation. These resources are specially useful for studying structures like bell towers, which aren't very big, but indeed complex, due to their elements and construction systems: load-bearing walls, arches, vaults, floor slabs, frameworks, as well as ornaments. As a result of the systematization of the graphic documentation process, the working team requires just two people to carry out the task. However, the most important issue here is to understand and depict the structures and to have a certain knowledge of the new data capture resources currently available. The study of bell towers, aimed at documenting this extraordinary structures, enables both the understanding of such constructions and also the design of an "exportable" working methodology intended to enrich the students' competences. Another important aspect of our study on bell towers was the use of sketching as the graphic tool of thought. Sketching is an essential means of analyzing and thoroughly knowing the composition and architectonic elements which need to be synthesized in the final product.

Keywords Teaching · Documentation · Data collection

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Historically, the need to measure the height of buildings in order to represent them accurately has led to difficulties that have precipitated the development of methodologies and technical resources.

In this regard, the Cósimo de Bartoli (Fig. 1) image shows one of the resources he includes in his text, where he describes how to measure the height of a tower using topographical methods based on constructing triangles through measurement of angles and distances.

Bartoli's work is one of the first historical references to the advancements that have ultimately led to today's digital technologies devoted to the collection of data on existing architectural structures, in particular data on height measurement that offer the precision and reliability demanded in technical representations.

Gone are the plane table and the intersection method, as well as photogrammetry, which involved initial analog reconstructions followed by analytic procedures.

These developments were made possible thanks to converging advances in the fields of mechanics, optics and photography (Fernández 1997).

Today the collection of data on architectural structures, whether height, width or length, is achieved by digital technologies which our Graphic Expression Departments have been acquiring. These new technologies, applied to the study of

Fig. 1 Cósimo Bartoli, Concerning the Measurement of Distance…, 1564

existing architectural structures, allow for the creation of representations that are both highly precise and faithful to the architectural object, to the point where the model that is created can take the place of the original as the basis for performing reconstruction and analysis.

Among the new technologies generally used to document heritage sites are laser scanners and digital photogrammetry programs. While some of these resources (especially scanners) are costly, others are economically within reach or even free in the case of some software, allowing the acquisition of more appropriate equipment with respect to precision data gathering and image resolution (Álvaro 2014) (Fig. 2).

Along with these new tools, drones in combination with digital still and video cameras offer invaluable possibilities for collecting aerial data, allowing the creation of images of building sections that cannot be accessed with other techniques.

Among the advantages of using these technologies for fieldwork data collection are their ever-increasing simplicity of use and the requirement of no more than a couple available individuals with a certain level of mastery of the new digital technological resources. This allows them to move beyond the iron control of the instructor to become yet another student development tool in a world where a large

Fig. 2 Point cloud, Church of the Nativity, Villasandino, Burgos

part of the technology that surrounds us is digital. Drones are the exception, since regulations regarding their use create significant operational limitations.

In this way, the new digital tools are not simply utilizable by students in introductory courses; they also greatly simplify the collection of measurement data, becoming extremely valuable to the study of vertical edifices. Thus student participation becomes possible in the study of constructions like the bell towers; structures that may not be considered major in comparison to a building but which are nevertheless complex in organization due to the construction-related elements and systems that make up their composition (Figs. 3 and 4).

The study offers a twofold instructional benefit: first because it permits hands-on access by students to the new technologies, and also because it is a means for achieving an understanding of the compositional and constructional aspects of these uniquely didactic structures.

In effect, the towers have acquired an entire repertory of architectural elements in the course of their vertical development, aimed at meeting the challenge of tall constructions, and at connecting the spaces associated with these structures. We are

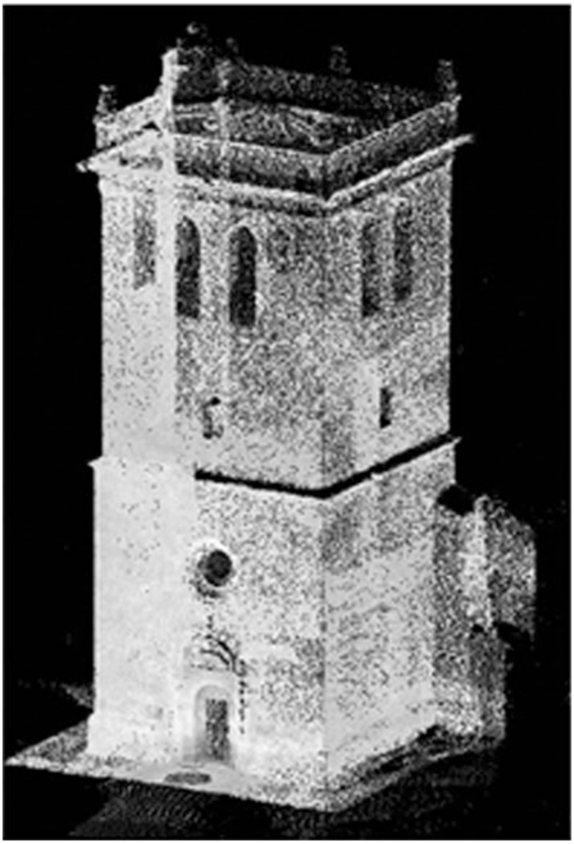

Fig. 3 Church of San Pedro, Castrillo Solarana, Burgos

Fig. 4 Church of Santiago, Castrillo de Murcia, Burgos

referring to bearing walls, arches, vaults, floor slabs and frameworks as well as straight-flight or spiral staircases, in addition to the decorative and stylistic elements that adorn their façades.

The concept was tested through the study of 16th-century towers in the Province of Burgos, giving rise to the idea of making use of these architectural structures in the academic environment, source of architectural and technical knowledge.

1 Concatenation of Structures

The liturgical needs established by the Council of Trent in the mid-16th century resulted in the placement of a baptistry at the lower level of the towers, creating a direct and translucent passage between the naves of the church and the base of the tower where the baptismal font is now located. Above these spaces devoted to baptism was the choir, which held a special importance in view of its elevated location and its role as an extension of the temple devoted to the cantors who solemnized the new liturgy.

Both the choir as well as the sub-choir beneath it acquired greater solidity and ornateness with the construction of star-shaped rib vaults in the Gothic style (Palacios 2009, 57–67). Such vaults prevent vertical passage in the tower, necessitating the construction of an exterior staircase, usually spiral, to connect all the spaces contained in the tower. The clock chamber (providing space to suspend the clock weights) and the bell tower developed thereafter, sometimes with several levels to house the bells and rattles (Figs. 5 and 6).

Nevertheless, all these interior divisions were generally imperceptible from the outside. The 15th century saw a persistence of the medieval practice of arranging progressively smaller levels one on top of the next, with the imposts that separated them revealing their stratification to external observers. However, the tendency during the 16th century was to eliminate these horizontal divisions and reduce the thickness of the inside walls, leaving only the main body of the edifice and the bell tower distinguishable from outside the structure.

Fig. 5 Church of Santiago, Castrillo de Murcia, Burgos

Fig. 6 Churches, Burgos San Martín Obispo. Churches, Burgos

At the same time, the tower's prism crosses the spiral staircase that links all the interior chambers, its form ranging from hexagonal or octagonal to cylindrical. Its crown is one of the great esthetic themes of 16th century towers.

If the tower was situated at the base of the temple (which was the usual case), it sometimes also served as a portico, allowing passage through its lower level, which then no longer served as a baptistry. This practice, which was frequent among late medieval towers, was abandoned following the Council of Trent, when the construction of the baptistry at the base became widespread. In many instances, porticos were walled off and transformed into baptistries from that point onward.

From a formal consideration, the bell towers constitute a landmark distinguished by their height amid the urban landscape. In addition, they serve to situate the temple and even the town itself in the distance. The view of their crowns is a reference point, a beacon that marks their position, an image that identifies and at the same time symbolizes both the temple and the urban complex.

From a constructive viewpoint, they constitute a particularly complex element that brings together various structural systems in their construction. The different levels of the tower are formed by a stone bearing wall, which diminishes in thickness by stages on the interior side as we ascend the tower. In this way, a closed box with square or rectangular sections is created, with openings above to

Fig. 7 Church of the Holy Cross, Tordomar, Burgos

illuminate the interior. At the uppermost level, the walls are opened up by double semicircular arches at the location of the bells.

The openings in the lower section offer a greater variety of approaches. In those cases where the tower is attached to one of the sides of the church, its wall is completely enclosed while, in cases where towers form a colonnade at the foot of the temple, the wall forms a large molded arch. A third approach integrates the tower into the temple, becoming the first section of its central nave; in this case a linteled façade situated at the symmetry axis provides access beneath the tower to the temple (Fig. 7).

Another highly significant opening occurs in those towers where the first level contains the choir of the temple. In such cases, the wall face between tower and church opens to form a grand triumphal arch that connects the tower's interior with that of the temple's central nave.

With regard to the ceilings of the different levels of the towers, in general the lower levels, as previously described, are covered with ribbed vaults that feature liernes, tiercerons and arched ribs, with identical vaulting in the tower's lowest level. The other levels feature wooden beams and joists to configure the different slabs as well as the hipped roof that caps the belfry level.

2 Work Method

While it is true that the newly developed technologies have superseded the difficulties of precise measurement at heights, that is, in inaccessible parts of a tower's exterior, the same cannot be said for the collection of data in interior rooms where spatial constrictions or the instability or irregularity of the slabs due to structural deterioration make it difficult if not impossible to operate the equipment that is based on these technologies.

Such circumstances require utilization of a mixed measurement system in order to achieve effective data collection using techniques that lend themselves to the creation of two- and three-dimensional analytical representations. Thus the new technologies are used for the exteriors while direct measurement must be used inside the towers (Fig. 8).

The 3D laser scanner makes it possible to capture the towers' external geometry, supplying precise and detailed three-dimensional coordinates of the exterior walls by means of point clouds (XYZ coordinate systems) with which a virtual substitute model of the three-dimensional reality of the architectural element can be defined.

For inaccessible parts of the building, the use of unmanned aerial vehicles (UAVs) facilitates the capture of photographic images that can make it possible, by means of specific software, to create three-dimensional formal and geometrical models of those parts that cannot be accessed by the scanner, combining these representations with the scanned data (Fig. 9).

Interior sketching, far from being simply a technique for recording measurement data, constitutes a process for understanding the architectural object. The observation and examination of general and detailed aspects of the object under study establish an analytical process of understanding the form and elements involved in the construction of the tower along with the state of conservation of the construction and structure. This process leads to a graphic synthesis of the object. In this

Fig. 8 Data collection using scanners and sketching

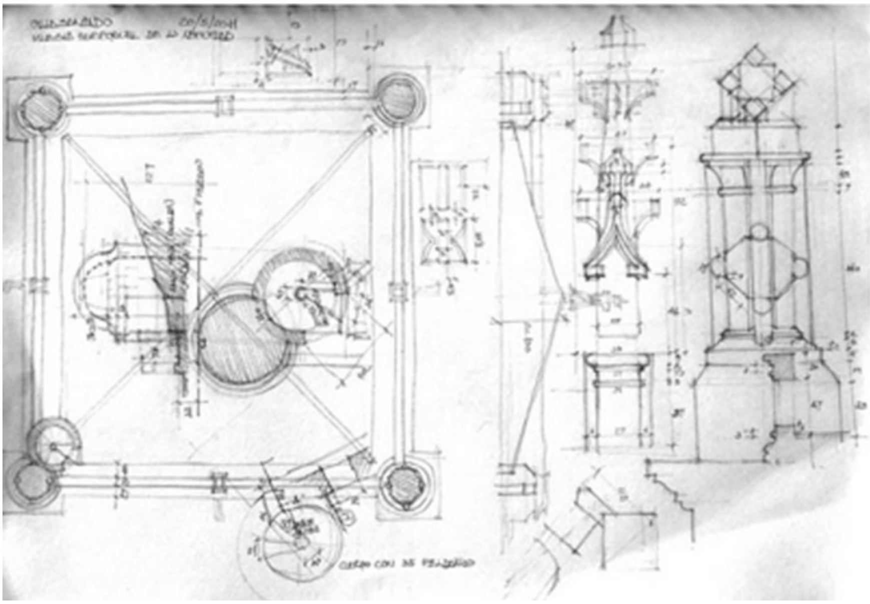

Fig. 9 Detailed sketch of the crown of the tower at Villasandino, Burgos

investigatory process, the dimensions of the elements included in the representation constitute the most important data from a documentary perspective in this phase of the architectural study.

3 Processing Field Data

In data collection, the processing of the gathered information leads to the analysis and reworking of the collected documentation through a process in which the successive application of a series of computer programs ultimately generates the graphic media that represent and describe the towers (Fig. 10).

As a first step, the various point clouds are organized or grouped together to form a single 3D model containing the tower's complete geometrical data and formal characteristics.[1] This makes it possible to review measures, formal alterations, collapses, deformities and all those aspects connected with the form and geometry of the architectural element.

Through the 3D model, the data necessary for the creation of conventional representations of floor plan, elevation and cross section can be generated.

[1]Software employed in the creation of precise polygonal models by means of scanned high-density point clouds may be generic or specific to the scanner being used.

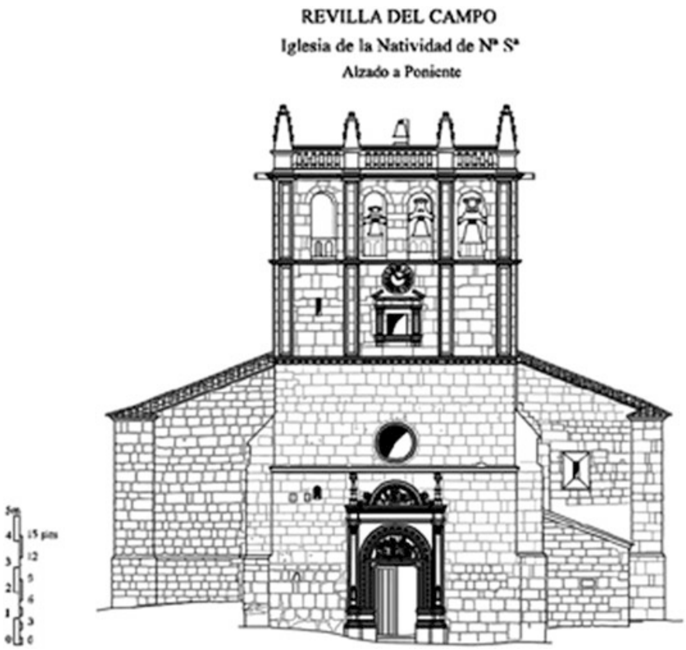

Fig. 10 Elevation of the west façade of the Church of the Nativity of Our Lady, Revilla del Campo, Burgos

To achieve this, a new digital process[2] is launched that involves "slicing" the 3D model both vertically and horizontally to provide orthogonal projections of the façades in point clouds and horizontal profiles of the various tower levels under consideration. Once this documentation is exported to CAD, it becomes possible to generate the geometrics and form of the elevations by tracing the 3D model (Fig. 11).

On the other hand, the development of the floor plans requires a dual process: first defining the exterior contours using the profiles generated with UVACAD, then constructing the interior description based on the data gathered through the sketching and dimensioning of the interior spaces.

Particularly valuable in this phase are the photos taken during fieldwork, not only because they can evoke what was observed and clarify specific aspects, but primarily because they constitute the database that represents, in its graphic media, the disintegration of the stone walls, their texture, and even the color of the materials used in the tower construction.

[2]In this phase of the process, work is done using UVACAD, a software program developed by the LFA-DAVAP group of the University of Valladolid to further the use of point cloud models.

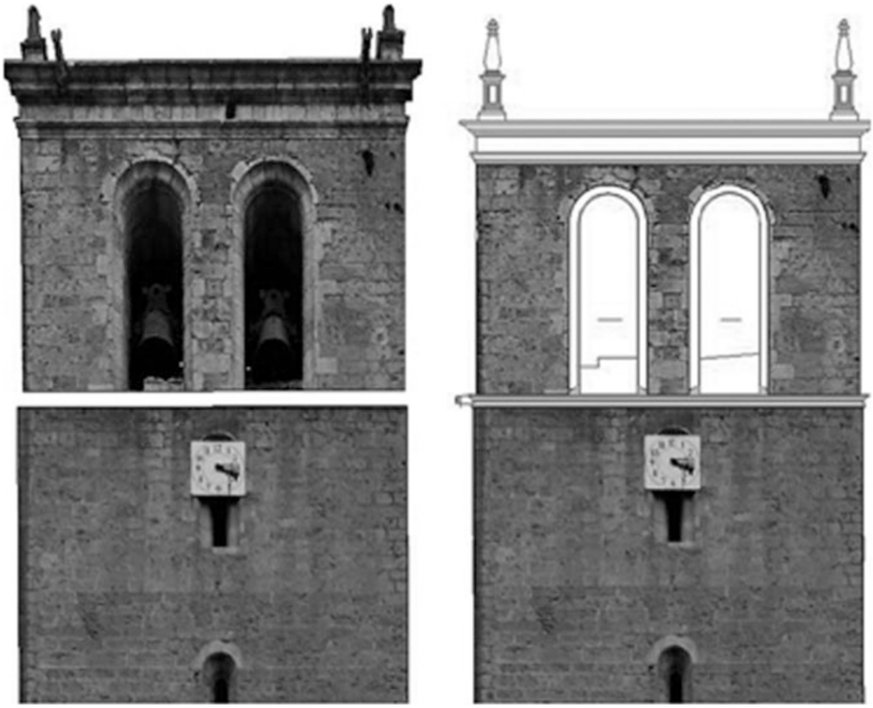

Fig. 11 Rectified image of the upper tower section, Santa Ana Collegiate Church, Peñaranda de Duero, Burgos

There are two methods used to incorporate the disintegration of the ashlars and masonry into the process of representing the tower walls.[3] One involves the rectification of photographic images, providing both the way to assemble the masonry and the texture and color with a logical limitation—the elements and sections with surfaces that cannot be portrayed on a plane. The other consists of the "homographic rectification" of the drawing of the disintegration and other formal aspects.

Homography provides a way to analyze the disintegration and pathologies of the tower walls through the interpretation of the information contained in the photographic images. This allows a layered sorting of the information on the formal aspects.

[3]Together with the digital image of the facings that ASRix provides; HOMOGRAF has been the drawing tool used to represent the disintegration of the facings, given the program's ability to perform homographic transformations of line drawings.

4 Models and Graphic Synthesis

The analytical process requires the development of three-dimensional models from the data and descriptions grounded in the orthogonal projections of the floor plans, elevations and cross sections. These digital models are built in CAD, where the formal descriptions of each element and component of the tower's architectural configuration are neatly sorted.

An essential graphic resource in these models is the cross section—a graphic device that permits visualization of the interior spaces of the tower as well as the disposition of its construction elements and systems. In addition, this resource makes it possible to express the relation of all the spaces with the levels and openings that determine the exterior composition.

The complexity of these architectural organisms necessitates the generation of multiple sections of the layout under study, which eliminate part of the walls and interior structures in order to clarify the organization of the entire structure and the disposition of its parts: the layout of the stairs and how they connect to the different levels of the tower, the structural composition of the tower's floor slabs and the vaulting above its spaces, the shape of the decorative elements, which identifies the architectural style, and so forth (Fig. 12).

The resulting diagram is a synthetic and analytical representation explaining the formal, constructive, and organizational aspects of the tower, achieved by

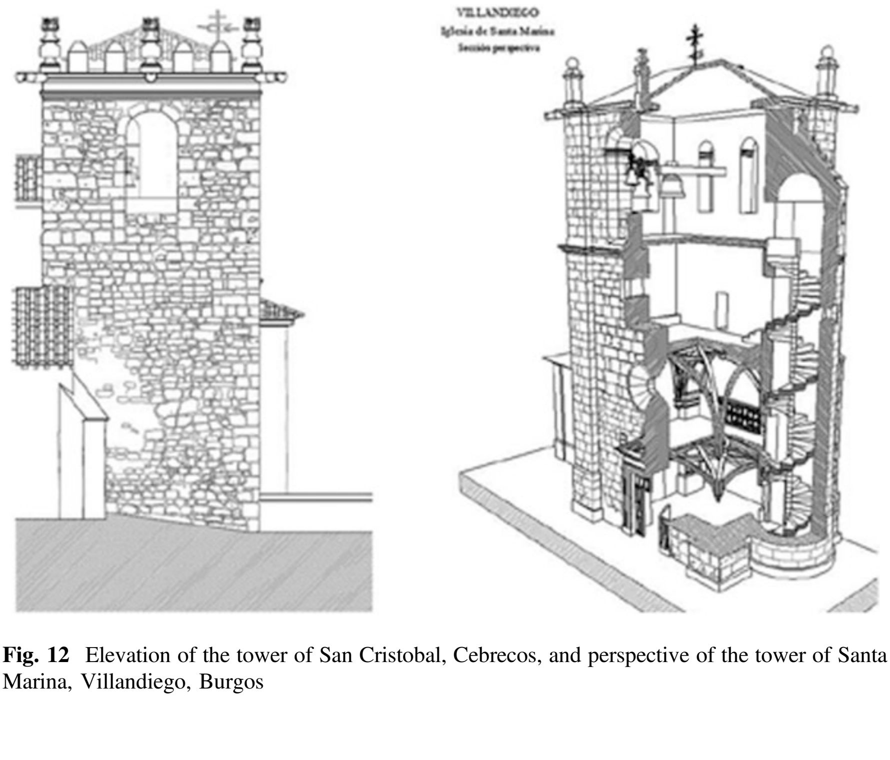

Fig. 12 Elevation of the tower of San Cristobal, Cebrecos, and perspective of the tower of Santa Marina, Villandiego, Burgos

converting the knowledge obtained from the analytical development process into drawings, a process that leads to an understanding of three aspects related to the complex organization of the towers:

– The compositional laws that establish the articulation among the tower's elements and structures.
– The knowledge of the systems and elements that, taken together, form the constructive definition of each structure.
– The organization of the surfaces through an analysis of the disintegration, the composition of the masonry, and the disposition and form of its openings.

In turn, the analytical process must lead to an understanding of the modifications and alterations that have occurred in the course of the tower's existence through the study of the remnants and bits of evidence that the structure itself provides. This makes it possible to create three-dimensional representations that reveal the state of the tower in earlier times, thus permitting an understanding of the structure's evolution through comparison with its current state.

5 Conclusion

The combination of current 3D data-gathering systems and conventional direct measurement techniques is proving to be an effective resource for documenting and studying vertical constructions, based on the following factors:

– The resources utilized guarantee precise measurements of the three dimensions of space
– The time devoted to fieldwork is reduced
– Fewer staff are needed to collect data
– The method enables a detailed understanding of the whole and the parts of the architectural asset.

A thorough visit to the architectural object is essential to reach a detailed understanding and achieve good documentation, and also key to interpreting the data that one collects. This approach, far from introducing subjectivity into the analytical process, allows us to establish the criteria to express the understanding obtained and to guide the graphic media in synthesizing the results of the analysis.

In this sense, this type of work is understood as an activity that should involve the participation of students from the initial years onwards, and should not be reserved for graduate or masters students, who would be better suited to take on larger tasks appropriate to their level of mastery of the tools and the analytical process.

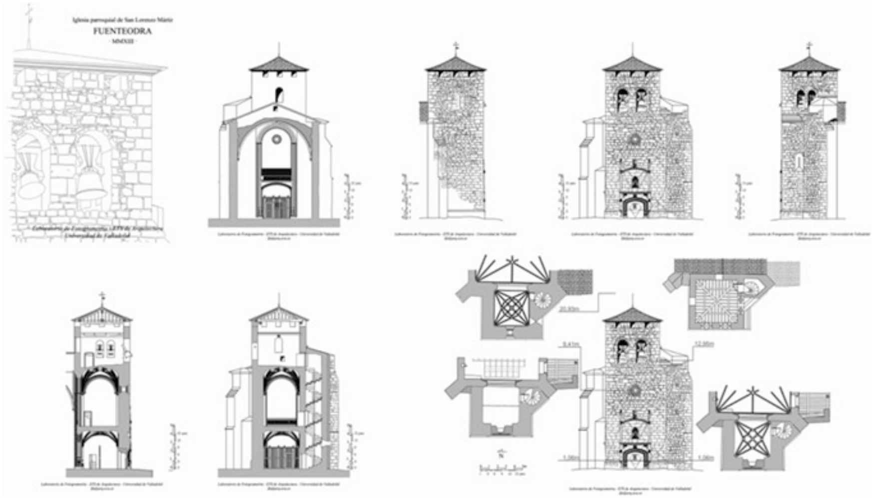

Fig. 13 Planimetries of the tower of the Church of San Lorenzo, Fuenteodra, Burgos

Thus the difficulty lies not in the data collection by means of new technologies,[4] but in knowing what to do with such information, and in providing the training to equip the student for the tasks of analyzing and understanding architectural complexity and, only at that point, in representing the information. In the case of these vertical architectural structures, for the sake of producing complete and precise documentation. Ultimately, in generating architectural studies where, as López Vilchez has said about pre-Renaissance graphic and technical representations, *one seeks not to transfer truthfully the forms of the object, but to heighten the very understanding of it…* (López 2011, 155) (Fig. 13).

Works, therefore, that focus not just on creating “pretty drawings” but on achieving effective representations of these architectural organisms in order to understand and explain them, their structures and their constructive systems.

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[4]After all, an entire generation of colleagues and, in general, our students are digital natives who have cut their teeth with information technology in their hands. Even those of us who are—paraphrasing Professor Lino Cabezas—in the *pre-keyboard generation* have learned how to get on board the digital train.

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Ethic and Aesthetic: The Role of Early Illustrations in Serlio's Book of Antiquities

Gonzalo Muñoz Vera

Abstract Serlio's treatise on architecture, *Architettura* (1547), undoubtedly set a precedent in the way this discipline started to be taught through early printed books from the Renaissance. Unlike others treatises from that time, which were mostly written in Latin and addressed to patrons and scholars, Serlio's *Architettura* was intended as a didactic educational architectural guidebook, easily comprehensible to anyone interested in this discipline. Perhaps one of the main characteristics of his treatise was the way he included illustrations throughout the seven books that composed *Architettura*. Significant in this regard was the painter background Serlio had, beside what he learned from Baldassarre Peruzzi, which allowed him to conceive a cohesive graphic language along with the text in the pages of *Architettura*. Thereby, we found a book devoted completely to ancient buildings (Book III—On Antiquities), compiling "if not all, then at least a majority of those antiquities so that any person who enjoyed architecture could, wherever they find themselves, take this book to hand and see all the marvelous ruins of those Roman buildings." (Serlio, S., Hart, V., & Hicks, P. (1996). *Sebastiano Serlio on architecture*. New Haven, Conn: Yale, p. 97.). This particular book could perfectly be defined as a *protoatlas* of illustrated ancient architecture by those days. It was innovative not only in what and how was showed for the first time, but also in fostering a taste for "exemplar" architecture with an emphasis for an "universal purpose" through these illustrated and selected monuments. This essay seeks to review Serlio's main leitmotifs in how he initiated a new era of illustrated architectural treatises, where images were deliberately included and then were an inseparable part of these books, playing a decisive role in the field of ethic and aesthetic in the architectural education from that period. For this, the focus has been centered on three main issues selected particularly from Serlio's Book III: (a) the importance of learning from Antiquity; (b) the role of Illustrations as records of ancient buildings and (c) the Judgment looking for Beauty.

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The way in how we understand, perceive and disseminate architectural information mostly has had a profound link with visual experiences. John Berger exemplifies clearly that link with those childhood days and the discovering of the outside world: "Seeing comes before words. The child looks and recognize before it can speak." (Berger 2000, 13). We *consume* images to get informed: drawings, sketches, diagrams, photography or any other kind of visual media. The image has been thus a crucial issue in the manner we communicate, not only among colleagues, but also with the people. We acknowledge an image dependency as part of the architectural speech from long time ago.

Serlio's treatise on architecture, *Architettura* (1547), undoubtedly set a precedent in the way this discipline started to be taught through early printed books from the Renaissance. Unlike others treatises from that time, which were mostly written in Latin and addressed to patrons and scholars, Serlio's *Architettura* was intended as a didactic educational architectural guidebook, easily comprehensible to anyone who was interested in this discipline. Perhaps one of the main characteristics of his treatise was the way he included illustrations throughout the seven books that composed *Architettura*. Significant in this regard was the painter background Serlio had, beside what he learned from Baldassarre Peruzzi, which allowed him to conceive a cohesive graphic language along with the text in the pages of *Architettura*. Thereby, we found a book devoted completely to ancient buildings (Book III—On Antiquities), compiling "if not all, then at least a majority of those antiquities so that any person who enjoyed architecture could, wherever they find themselves, take this book to hand and see all the marvelous ruins of those Roman buildings" (Hart and Hicks 1996, 97). This particular book could perfectly be defined as a *protoatlas* of illustrated ancient architecture by those days. It was innovative not only in what and how was showed for the first time inside it, but also in fostering a taste for "exemplar" architecture with an emphasis for an "universal purpose" through these illustrated and selected monuments.

This essay seeks to review Serlio's main leitmotifs in how he initiated a new era of illustrated architectural treatises, where images were deliberately included and then were an inseparable part of these books, playing a decisive role in the field of ethic and aesthetic in the architectural education from that period. For this, the focus has been centered on three main issues selected particularly from Serlio's Book III: (a) the importance of learning from Antiquity; (b) the role of Illustrations as records of ancient buildings and (c) the Judgment looking for Beauty.

1 Antiquity

In the 16th-century this concept was undoubtedly a fecund source of inspiration, especially for artists and scholars. Travels around Europe looking for ruins and old monuments were a relevant issue in the constructing learning process, based mainly on the unavoidable experiential instance of being there physically. With the advent of Serlio's Book III, these places of interest "were no longer the exclusive purview of Humanist writers or the readers of their texts, which often lacked illustrations and were predominantly written in Latin", as Rowe and Satkowski sustain. The sites in where these antiquities were located seemed to be closer than ever with this Book III, and consequently "antiquity was demystified through publications that simplified the application of the orders and illustrated a wide range of ancient and modern architecture" (Rowe and Satkowski 2002, 128). In the Book III, Serlio also mentions that if one of these buildings would not been still standing, it would be impossible to believe that once these existed. People were facing the "First example of community without proximity (…). For many Renaissance architects, the Pantheon and the Colosseum were not places in Rome. They were places in books" (Carpo 2003, 82). On the one hand distance seems to be no longer an obstacle for watching any monument. On the other, it is in Serlio who readers trusted their eyes (Fig. 1).

Consequently, Serlio not only showed heritage richness through the selected roman buildings displayed in his treatise. Besides the architectural project he illustrated at the end of Book III, he also wanted to share information about ancient roman culture by mean of the frontispiece of this book. Desley Luscombe has greatly examined the meanings of every element in this frontispiece. The importance to learn from the past is again crucial and the main subject in the cover of Serlio's Book III. For instance, the *lemma* in the upper side of the illustrated portico in this frontispiece aims to a call for recognizing the past and to work from it. Serlio modified a very well known ancient roman motto in order to encourage us to conceive the past as a source of knowledge and involvement, instead of ruination and forgetfulness. "*Roma quanta fuit ipsa ruina docel*" (the former greatness of Rome is taught to us by the ruins). Hence, Luscombe (2005, 36) *adds* "that the portico and ruins [in the frontispiece] are not to be read as representing a scene of devastation whose inevitable decay had lost the beauty' of the architectural antiquities." The importance of *iconography* in Serlio's work "reinforces a representation of the architect as the person able to determine order because of his capacity to resolve the competing requirements of their historical and physical context with the principles emerging from antiquity" (Ibid., 39).

From his master Baldassare Peruzzi Serlio learned and produced most of the material displayed in *Architettura*. It was achieved especially from their travels through Italy and learning from its antiquity. In this regard, drawing and measure were keys methods to get the information around. Peruzzi and Serlio shared a past as painters and they were well versed in this matter. As Serlio remarks constantly through his treatise, "(…) the best architects of his time all began as painters and

Fig. 1 Frontispiece of Book III—on antiquities

that consequently a knowledge of the *costruzione legittima* was crucial for architects" (Pérez Gómez and Pelletier 1997, 22). However it was Serlio who could finally publish the illustrations made from those ancient places, inspired mainly in his master's work. Rowe and Satkowski claim that "From these antiquities old and new, a different kind of architect emerged… architectural practice was now a work of art" (Rowe and Satkowski 2002, 155).

Onians (1988, 263) considers, based on Serlio's words on Book III, that: "the third book should not be seen just as a collection of delightful and beautiful buildings, but that its text provides a guide to 'the selection of the beautiful [*elettione del bello*].'" So, we could say that apparently the Book III was intended not to be as a whole catalogue, but a critical text depicting ancient roman buildings and noting specific details in their designs, as well as in the architectural drawings produced from them. Serlio was also critic with who followed ancient buildings as models to imitate. He is clear in showing good and bad practices through these old examples displayed (i.e.: his criticism of the baths of Diocletian). Similarly he criticizes who took Vitruvian learning as a mandatory and indisputable canon. In this regard, Onians agrees Serlio's insights indicating that "It is not enough for a modern architect to be able to point to antique precedent as justification for a particular detail. The ancient often erred, and we should 'hold to doctrine of Vitruvius as guide and infallible rule'" (1988, 263).

Serlio complements: 'And to you, supporters and defenders of ancient things, please excuse me if in my speaking I have offended you. However, I always put my trust in the judgment of those who know' (Serlio; Book III fol. 94v).

Thus, we could infer that a compilation of marvellous buildings was not enough for Serlio in teaching about how to conceive a meaningful architecture. Learning from the past and by mean of illustrations were for Serlio just some ways to improve architectural design methods. Consequently, and according to Onians (1988, 268), "his goal [Serlio] was not just to develop what is in effect the first analytical vocabulary of architectural style, but specifically to develop the *giudicio* of his readers, so that they would be able not only to differentiate styles but to choose the best one."

2 Illustrations

Unlike his predecessors, Serlio made his treatise based on architectural drawings as a key and supplementary feature. He simply relied on the idea that the task of an architect is primarily to create and then to put down on a paper the design for any construction. For him the execution of such a design, contemplating all the problems of laying foundations, choosing materials, and erecting vaults, would be a task for others. Thus, Serlio "saw himself as the spokesman of the modern approach to architecture as illustrated by Bramante and his followers, and the first feature of this modern approach was its starting point in the sphere of painting and drawing" (Onians 1988, 264). It should be noted that Serlio developed in *Architettura* a book dedicated exclusively to Perspective (Book II—On Perspective), displaying a noticeable didactic way to get perspectival drawings. Clearly his background as painter was key in this regard, becoming "(…) the first architectural writer to include a full chapter on perspective" (Pérez Gómez and Pelletier 1997, 22). Also remarkable was the use of the *linee occulte*, as an imaginary line useful to get perspectives. Serlio states that this imaginary condition is fundamental for architects. Furthermore he associates this matter in relation with the study of human body: "we know we have skeleton but we cannot see it". This latter also had echoes in Giordano Bruno's conception of *vinculi*, where "Invisible lines, *linne occulte*, and *vinculi* are implicit in a line of text, the function of which is to connect words to ideas and meaning" (Saiber 2005, 76).

Historians of those times debated about the absence of a theory of architecture presented in this so-called illustrated architectural manual. But this was completely refuted in Serlio's *Architettura*. Especially in Book III, where it was possible to contrast and complement text along with *powerful images*. For Rowe and Satkowski (2002, 128) "This kind of 'unwritten' theory derives from the selection, description, and ordering of architectural images in order to articulate an idea." Hence, it was crucial the development of the architectural drawings in search for a closer and more detailed approach to ancient buildings, clearly embodied in Serlio's Book III. Images were not alone in the Book III, despite of the clear predominance of a fully conceived illustrated treatise. The role of the text throughout the pages of *Architettura* was evident and synergic. This fitted perfectly with Serlio's main aim in producing an easily comprehensible book for anyone who feels the need to learn without being necessarily a scholar. This latter is strongly supported by the idea expressed by Rowe and Satkowski (2002, 128) in where "A more accurate assessment is that the authors of the illustrated manuals were perhaps disdainful of humanism and the admittedly obscure erudition found in Alberti, preferring instead to address real problems faced by architects of their time." This exceptional aim in performing an architectural treatise has to be developed differently about how to communicate the ideas. As Hart and Hicks (1996, xx) remark: "In communicating concepts which were otherwise difficult to describe, these figures formed a vital didactic tool and also greatly assisted the *Architettura'*s subsequent translators. Serlio's text remains more or less strictly 'bounded' by the outline of the figures, in both its content and its physical shape." According to Hart (1998, 171), for Serlio the involving between words and images create the expression 'visible design' (*disegno visible/disegno apparente*) placing the text supporting the images "as it were 'invisible', expression of the design." Along with the text, the "sense of sight" in the comprehension of ancient buildings based on "simplicity and clarity" brought an architectural manual available to the majority. Onians (1988, 269) faces it arguing that "Just as Cicero and his contemporaries developed their own rhetorical style by studying that of the period and people whose speeches they most admired, so Serlio felt that the same could be done for architecture." (Fig. 2).

Serlio displays the roman Pantheon as the first illustrated example in his Book III, which is for him one of the most noteworthy works of architecture. This was due basically to its very well achieved proportion and referential to the most perfect form for him: the *rotoundity*. Serlio mainly uses in this book three kinds of architectural drawings to illustrate these buildings: (a) *iconografia* (plan); (b) *ortografia* (elevation or section); (c) *sciografia* (front and sides). Furthermore he shows detailed analytical illustrations to focus on specific points on the buildings depicted. Serlio's plates helped to "standardize the drawing projections used in the Renaissance and in subsequent architectural treatises in particular" (Hart and Hicks 1996, xx). Also it was remarkable how Serlio illustrated those buildings, using exactly the same scale in the drawings, as we can see with the Pantheon. When Serlio explains and shows the roman Coliseum, he uses just one plan to illustrate simultaneously the four stories in that building, dividing the plan in four equal parts. Also, when Serlio is referring to the Amphitheatre of Verona he uses the same

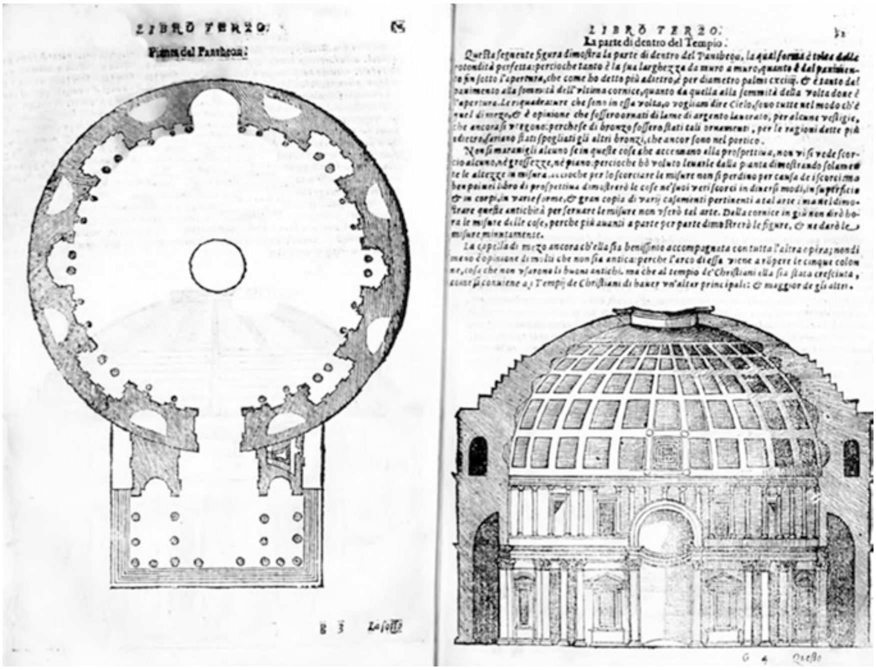

Fig. 2 Roman Pantheon in plan and section

method for showing stories in the plan. Besides, he is simultaneously incorporating a section inside that plan. The Coliseum is then showed in section (partially) detailing some of its stairs, cornices, and finally showing a fragment of his main façade (all of them in perspective). So we have it fully showed only in plan. Thus, it could be said that the main purpose of bringing to the readers a *presence* of this monument it was not completely achieved. It is not the only case in this Book III, where another amphitheatres were also showed incompletely. So, it would be through the reader's envisioning (connecting words to ideas, meaning and images) the ideal way to get a more complete image of the Coliseum. Moreover, knowing that they were romans monuments, the relationship with an immediate site was mainly omitted by these drawings. Thus, the reader should have to imagine the surrounding place of these monuments. Probably this issue was of no importance in Serlio's drawings, but it was in the text.

Three dimensionality, depth, shade and perspective appear as main characteristics of the *sciografia* developed by Serlio, especially when we see the Pantheon's drawings in Book III. These illustrations were basically achieved through "geometric and mensural accuracy" whose importance, according to Luscombe (2005, 43), "could form for the architect, a distinctive relationship between architecture, its representation and his conventions of thought." Serlio is selective in how and when he uses *sciografia*, looking for a methodical clarity. He applies it for instance in the interior elevation of the Pantheon "to show three-dimensionality of the receding curvilinear elevation". As said by Luscombe, Serlio clarifies that in searching for the most representative illustrations of ancient buildings *sciografia* could be worked better along with shading or pictorial features in emulating depth perception in buildings. But perspectival techniques should remain close methodical means. Thus, Serlio conceived Book III's drawings intentionally different to the rest, in order to produce a book that allows showing illustrations as eloquent records rather than practical ones. Serlio in some way was sharing what he saw, what he experienced through these *sciografias*. We can infer that Serlio could have thought that in this way the reader could be closer to these antiquities instead of using some others accurate images. Yet, taking consideration of the richness in drawing and composition of the Book III's frontispiece, Luscombe (2005, 44) also replies: "Without technical accuracy in the image, the symbolic references and metaphor would not be understood." She also argues "that the discipline of architecture including its techniques of representation, and intellectual purpose of the architect in creating notions of the social could be conceived in a single conceptual structure." (Figs. 3 and 4).

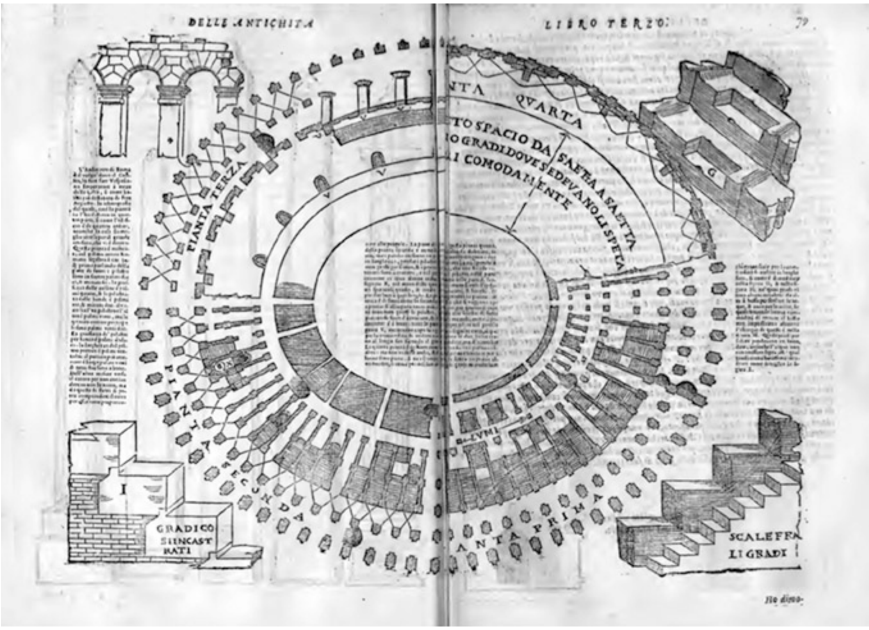

Fig. 3 Roman Coliseum in plan. "I shall not record the rest of the measurements towards the centre so as not to confuse, however the whole can be easily deduced from those for the exterior because everything is proportioned to its original" (fol. LXIIII, 78v)

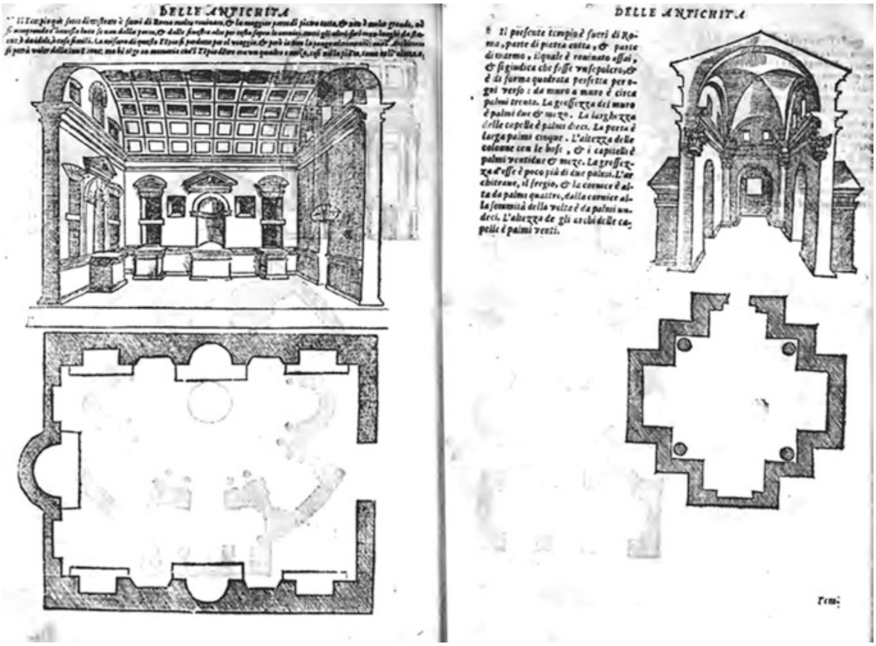

Fig. 4 Roman Temples. "The measurements of this temple got lost on the journey and so I will not give any others, but the architect can make good use of the invention. I do remember well, however, that the temple inside was a square and a half, both in plan and in height." (fol. XXXII, 62v)

3 Beauty and Judgment

Serlio's aim in not to produce mimesis from his examples nor even to follow completely the ancient rules of architecture left the way free to encourage architects to make their own judgments. Intrinsically, he pointed out a concept of beauty closer to an authoritarian creed. Furthermore, the only fact of showing just a selection of roman antiquities examples (ruled by a Vitruvian inclination) demonstrates a biased intention below his images and words. In fact, in one of these examples he considers not necessary the inclusion of temple of S. Pietro in Motorio's elevation (built by Bramante) pointing out that "because there was no beauty in the architecture I did not take any note of the elevation." (fol. 68v).

Serlio also makes differences between "good" and "bad" designs in Book III, stating that "it is my intention to distinguish well-conceived elements from those badly conceived" (fol. 70v). For Hart and Hicks (1996, xxiii) "His concept of beauty rested on the solution of difficult practical problems within Vitruvian rules, and in this respect once again the Pantheon was cited as an 'exemplar'."

But Serlio defends himself about a biased selection of the roman antiquities in his quest for architectural beauty on them:

> Perhaps it will seem to those who are intoxicated with Roman buildings that I am too bold in wanting to judge them… but it is one thing to imitate them exactly as they stand and another to know how to make a selection of the beautiful [*elettione del bello*] with the authority of Vitruvius and to reject the ugly [*bruto*] and badly understood [*mal intenso*]. And it is certain that the most beautiful quality in an architect is that he should not be deceived in his judgement [*giudicio*]. (fol. 99v)

The arrival of illustrations in architectural publishing established, as it has been said before, a consideration between theory and practice as the main content in these books, but also a discussion between ethics and aesthetics. According to Onians (1988, 271), Serlio considers that "the most beautiful quality in an architect is the ability to use visual judgment, employing an aesthetic term ('beautiful') to qualify an aesthetic gift." For Onians, taking this concept of beauty into account plus illustrated treatises, architecture "had been largely removed from the territory of ethics into the new one of aesthetics."

In looking for a "good judgment" through Book III's compilation of ancient roman buildings, Serlio points not only towards the content in his treatise, but also to the manifested experience. It is only in that manner that this good judgment is achieved. Luscombe (2005, 38) also sustains that Serlio "emphasizes the necessity for the architect to use reason and judgment in order to overcome the pitfalls of licentiousness in design. This can only be done through the evaluation of experience with regard to known principles. Serlio's sentiment raises the significance of reflection with regard to experience whereby good judgment is achieved."

Serlio mentions in the Book III: "Do not be surprised, reader, if I sometimes write at length on something because, as I said at the beginning, this is an art which is better taught conversing face to face than in writing and drawing." (fol. 37r).

Accordingly, we it could be said that an illustrated architectural book could only guide the sight on what the author wants to show, but never supersede the whole experience about being there. Thus, the readers should discern about the fidelity of the content in that book, according to their own interests. Serlio considered this autonomy sometimes pleasurable and dangerous. Again, the ancient building would be bound to this procedure from the beginning: "Throughout the text of Book IV, completed prior to Book III, Serlio demanded that the architect develop a personal *giudizio* through active examination and study of ruins" (Luscombe 2005, 45).

4 Conclusions

Architecture is bound to illustrations and with Serlio's treatise just the beginning of this was shown. Ethically, we may say that Serlio worked in order to produce an improved architecture in including his drawings to spread knowledge for everyone who was interested in this discipline. He worked close to Vitruvius' writings to produce from it his own images never provided by the *roman*. Serlio also contributed with his work in producing a graspable architecture, based on the abilities of sight and judgment. Grounded also in the ancient roots as patterns to learn from. So, ethically he comprised praxis among ancient rules and current architectural issues with drawings as the main supporter. Aesthetically, Serlio's work is much more abundant in examination. It became an unavoidable architectural publishing precedent whereof it was installed an almost perfect balance between texts and illustrations throughout *Architettura*'s books.

Ultimately, it could be said that an architectural publishing issue emerged from Serlio's treatises, especially by mean of the Book III. There it was born an artistic and mechanical way of communication increasingly becoming inherent to the architectural discourse. Far from there (Dinsmoor 1942), today we still assimilate visual this discourse as a pre-existed condition in performing architectural projects. Nowadays the way we talk and converse our ideas is mostly ruled by images as an unwritten and unspoken narrative. Additionally, the novelty just by novelty is most of the cases the aim of many in doing and producing current architecture. Additionally, it is worth mentioning the current quantity of architectural publications, which mostly encourage the usage of images above all other architectural graphic expression and text. Different from Serlio's times, Frampton (2001, 6) sustains that "our current tendency to reduce architecture to images (as well as everything else) has had an undoubtedly negative influence on professional practicing and it has supposed a change of intentions, and of course, of expectations, as of architects as well of clients." Thus, visual discourse is definitely leaving us with no speech, voiceless in front of a vortex of architectural production. In Roland Barthes' words (2001, 92): "I think that if humanity self-imposes a fundamental cultural task, it should be to teach men profoundly to talk…"

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Gonzalo Muñoz Vera Architect from the University of Chile (2007) and Ph.D. candidate at McGill University (2014–). Since 2005 he has studied the influence of images on the spread and understanding of architecture in architectural publications. His doctoral research topic is related to the current eruption of virtual reality and the dominance of visual media. His aim has been focused on the role that panoramas from the late eighteenth century have had on architectural representation as proto virtual media of distant places.

Architecture and Place: Teaching and Research Experiences in the Higher Technical College of Architecture of the University of Granada

Antonio García Bueno and Karina Medina Granados

Abstract The concept of place and feeling to the place, have changed over time and different cultural movements. Nowadays, in the new information, ecology and sustainability age, we want to create osmotic relationship between architecture and nature. When starting a new project, we must begin with a thorough knowledge of the environment and landscape, which involves identifying its constituent elements, their foreign references as well as the evolutionary and historical processes that have affected its configuration. This complex process should start from its own essence, which involve natural and cultural, tangible and intangible components. These elements have to be considered for study. They influence on their character and forms of perception. This work is part of a research and teaching experience, which is being conducted with students of architecture from different courses. Landscape and environment research is essential for the intrinsic value that they possess from the cultural point of view as a dynamic and complex reality where live many factors whose research can lead to interesting conclusions about the balance between architecture and place.

Keywords Place · Environment · Landscape

The concept of place and the sensitisation towards it have changed over time and across the different cultural movements. In Ancient Rome there was the belief that all independent beings had their *genius*, the *genius loci*, the protective spirit of the place.[1]

[1]A specific text on the evolution of the concepts of space and place is the one by Josep María Montaner, 1994. "Ensayo sobre arquitectura moderna y lugar" [Essay on modern architecture and place]. BAETSA, 18:4–11.

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Awareness about this such as it is understood in the present day, however, did not come about until the first half of the 20th century, when organic architecture paid special attention to the relationship of the discipline with this idea.

Under the new age of information, ecology and sustainability of our time, it involves creating osmotic relationships between architecture and nature. In recent times, a patrimonial character has been attributed to the landscape (natural and urban) as a morphological, functional and symbolic expression of both historical and modern relationships between society and surroundings.

The purpose of this communication is not to go over the various hypotheses formulated by philosophers and architects on space and place throughout history. It involves putting forward an experience carried out by Architectural Graphic Expression students from the Higher Technical College of Architecture of the University of Granada, in which the study of place as a conditioning factor for the origin, development and evolution of an architectural typology plays a crucial part.

1 Architecture and Place

When undertaking a new project, it is necessary to start from an exhaustive knowledge of surroundings and landscape, which means identifying their constituent elements, their external references, and their evolutionary and historical processes that have had an influence on their configuration.

This complex process must start from its essence, in which natural and cultural, material and immaterial, and tangible and intangible components are involved which, given that its character and different forms of perception are the result of the combination of these, have to be taken into account for study.

As indicated by relevant authors in the study of place, these are defined by the qualities of their elements, their symbolic, social and historical values and for their phenomenological relationship with the human body. This relationship of humans with their surroundings constitutes an instinctive habitat that is impossible to ignore.

In vernacular architecture, all of these elements can be clearly appreciated. As indicated in the Charter of the Built Vernacular Heritage (International Council on Monuments and Sites 1999), this is the fundamental expression of the identity of a community, as well as its relationships with the land, forming an integral part of the cultural landscape. This, together with its materials, structure, spaces, and its way of being utilised and interpreted, should mark the guidelines for action in these places.

The reason behind the choosing of this work is precisely the involvement and complexity that a possible action would have in this environment.

If any habitat is going to survive, it must evolve and adapt to the new times, to which it is essential for us to introduce elements of a contemporary nature in a harmonious way that contribute to its enrichment. For this task, the research of landscape and surroundings is crucial for the intrinsic value they hold from a cultural and architectural point of view. It involves a dynamic and complex reality where multiple factors coexist, whose study could result in interesting conclusions regarding balance between architecture and place.

Through this experience, there is an attempt at proposing a starting point, to orientate students in the study of place, and to carry out both morphological and phenomenological research of the same via graphic and written approaches, and other architectural language resources.

2 The Importance of Landscape Study

The basic objective put forward is to debate about the analysis of place and surroundings, and the vision held by the student of genius loci, via a series of approaches to place.

Defining or describing landscapes is a difficult task that fluctuates between various currents. It has a noticeable polysemic character that reflects its social and natural diversity. We must understand this polysemy as a tool for research and knowledge.

Article 1 of the European Landscape Convention (Council of Europe 2000) makes the following definition: "*Landscape* shall be understood as a part of the land as perceived by people, whose character is the result of the action and interaction of natural and/or human factors."

If we understand urban settlements as a social construct taking place in time, we may say that the current landscape shows us the territorial morphology and structure of the city, at the same time as it explains to us the different stages and vicissitudes that have occurred over its historical process. The landscape should be understood as a space that is lived in and used by humans, where footprints of their avatars are printed. It is essentially dynamic and the result of a number of societal interventions that have been developing it. This allows us to identify a series of characteristics and fluxes that, through their study, provide knowledge of the medium and its history.

In the case of historical cities, the importance of identity possessed by the landscape is very noticeable. As a creation of the human society that interacts with the nature that surrounds it, and of which it forms part, in a historical landscape we can see images that refer to the past and superimpose themselves on the present.

3 Landscape and Architecture. Multiscalar Study

Architecture as an element of the urban landscape is intimately linked to it, together with its territorial surroundings. Therefore, in order to study it and its environment it is extremely useful to call on a multiscalar approach that overlaps the different landscapes, and helps in our understanding. The analysis of the different scales of landscape, together with the significant elements in each one of these, lends meaning to the study of surroundings and place.

Three levels will be defined in the study:

The first, territorial context, understood as a physical-natural support with a number of economic-cultural characteristics. The general sense of the action, its geographical location, social organisation, nodes, nuclei, networks, etc. will be studied through this.
Secondly, the urban scale conditioned by location, where connections and internal relationships are investigated. This analysis will reveal empty and full spaces, the public and the private, limits and boundaries, etc.
Lastly, the third level: the detail. This stage will involve the study of public space as a crucial and model element that encapsulates social and urban history, impregnated with a great patrimonial value. Elements such as the distribution and proportion between free and constructed spaces, their typologies, transversal profiles, textures, hierarchies, landmarks of interests, focal points, etc. amongst many others, will help in the understanding and development of those elements that provide them with identity and meaning.

All of this information will be compiled and represented graphically, although it will be of little interest if it is not interpreted and evaluated. For an effective analysis it will be necessary to carry out an exercise to synthesise the basic information and reorganise it within a value system.

4 The Case of Sacromonte

In the city of Granada we have a unique settlement, Sacromonte, where nature is colonised, with an organic structure intrinsic to the land. A site outside the city walls, where urban borders are diluted. A place where the sacred, the cultural and the picturesque coexist in an attractive blend, constituting a site that doubles as a viewpoint that takes in the Alhambra, the valley of the River Darro, the city, the fertile plain and the Sierra Nevada mountain range. For all of these reasons it was considered a good example with a high teaching capacity in terms of study and analysis of the place and its relationships with the surroundings.

We start from the hypothesis that to study the place, this cannot be done just by looking, it must be lived as well as seen. The place means living it, speaking about it, acting within it… A first contact with the surroundings is proposed from the point of view of the inhabitant. To do this a meeting is organised with the purpose of getting to know the daily flow and activities generated in the neighbourhood Furthermore, an appointment is made with a representative of the area, such as the president of the residents' association, to obtain testimony of the concerns, preferences, lifestyles, etc. produced in the area being studied.

Table 1 Matrix with intrinsic elements and the environment that affect the place being studied

	Strengths	**Weaknesses**
Intrinsic analysis	Great landscape value Sustainable habitat Historical heritage	Very vulnerable Uncontrolled growth
	Opportunities	**Threats**
Environment analysis	Tourism City view	Staging

Via the testimony of this person, we can verify that a combination of processes and values are produced in the place, which imply opportunities and limitations for its inhabitants.

Students are asked to construct a matrix containing the premises to be taken into account when undertaking an analysis, considering both the elements that are intrinsic to the place and the environmental factors that affect it. To do so the strengths, weaknesses, opportunities and threats are shown. There is an identification of those elements that offer protection and those that are hostile, as well as those that are beneficial and vulnerable (Table 1).

To maintain these values, the essence of the place must remain. Positive aspects must be preserved, and weaknesses and threats transformed into opportunities.

Following this first contact, where students have had a first experience in the place, become aware of the social aspects and drawn a number of initial conclusions on the most relevant study aspects, the origins and history of the settlement will be studied. In order to do this a specific bibliography will be used, and graphic documentation will be analysed.

We analyse the first graphic references of Sacromonte and its caves on the Vico platform.[2] Then, on the Dalmau plan and then on the Contreras plan, a window appears on the corner with Sacromonte on a larger scale.

Other relevant documents are the texts of the romantic writers in the 18th century, which bear witness to the dynamic context of the era, where they describe its inhabitants, their customs and professions.

Once its origin and evolution are understood, a series of plans are elaborated in which the continuous change of scale produced in this habitat is taken into account. From the greatness of the landscape, to the cramped cave; from the strips of vegetation to the prickly pear, from the abrupt morphology of the terrain to the small plateau… Because of this a multiscalar study has been carried out where the most representative elements of each category have been evaluated, using the gradient to show the different levels produced.

[2]Print of the city of Granada made by the architect Ambrosio de Vico in the 16th century.

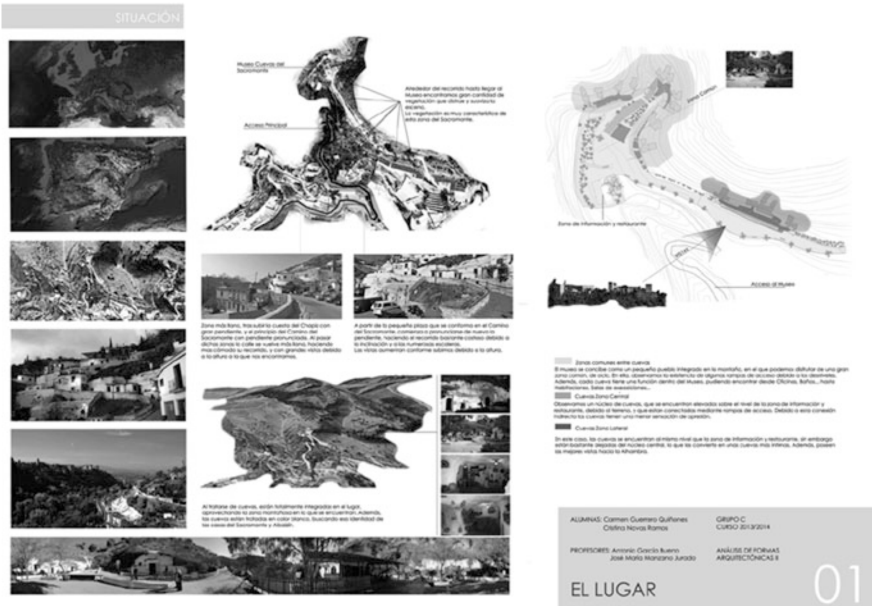

Fig. 1 Guerrero Quiñones, Carmen and Navas Ramos, Cristina. (2014) *Situación y emplazamiento del Museo Cuevas del Sacromonte.* [*Location and site of the Cuevas de Sacromonte Museum*]

To do so, we use the method of preferences. We identify the main value and represent it; then we continue with the secondary and tertiary values until the representation of the combination reveals the *intrinsic aptitudes* of the place.[3]

Work is started on the smallest scale, undertaking an initial plan with the geographical surroundings, where we can include their topography, geomorphology and hydrology, together with all of those natural or urban agents that deserve attention, appropriate for this scale. A stratification of cultural, urban, natural and scenic values and attributes is carried out.

In general, the bigger the area studied, the more pronounced the limits. However, as the scale approaches reality, the discontinuities are less noticeable (Fig. 1).

The long configuration of the River Darro and its valley organise the site in a long strip that runs along it. Its constructions are protected amongst the relief, and nature thus becomes the protagonist. They oblige one to approach the place to be able to capture images of their silhouettes.

As previously mentioned, at this level it is about studying territorial context in a physical-natural support and with a number of economic-cultural characteristics.

Because of this it is interesting to make a small mention of the socio-economic situation of the neighbourhood.

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[3]Concept addressed by McHarg ([1992] 2000).

It is depopulated, abandoned in the 60s due to a natural disaster. In 1962 and 1963, there were a number of floods that forced its evacuation, contributing to abandonment and deterioration of the landscape of this historically much valued settlement. It transformed into “what Denis Wood calls ‘shady spaces’—those hidden, marginal, uncontrolled places where the people can allow themselves to engage in behaviours prohibited elsewhere, without hurting others—threatened on a regular basis by clean-ups and which, nevertheless, constitute a need for a flexible society.” (Lynch and Southworth [1990] 2005, 38). In this posthumous work by Kevin Lynch, in which he invites us to think about the exhaustion and deterioration of the city, our attention is especially drawn to these *back* places, used by few people, where things are neither in order nor presentable, but highly expressive. “Professional planners know that these are the places that must be observed if one is going to get to know an area… They have the simplicity and easiness of well-established customs and familiar use. In many famous cities, these parts are not just revealing to the investigating eye, they also offer longer-lasting pleasures, if we stop being tourists”. (Lynch and Southworth [1990] 2005, 38). This text recalls the situation that has been lived in this settlement outside the city, and which for a number of decades has been undergoing a process of rediscovery by present day society. There is a socio-economic turn where new inhabitants, attracted by this cave-dwelling and picturesque habitat, are searching for a sustainable dwelling and an alternative lifestyle to that in the city. However, leisure and tourism are offering a distorted image of its historical and patrimonial importance, being transformed by a series of external demands that could endanger the harmony of the landscape.

At the second level of study, the urban scale, we appreciate how the curves of level draw the street plan. Narrow paths with steep and irregular gradients that, making use of the topography, widen to form small plateaus where viewpoints towards the landscape are formed, and we find the cave-dwellings, providing a high value to the site. From here you can appreciate how the relationship of the place with the surrounding landscape is crucial in order to understanding life in the area. “From the moment we’re born we try to orientate ourselves in the surroundings and establish a certain order in the same. A common order is called culture” (Norberg-Schulz 1972, 16).

The native environment studied has generated in this setting a culture that is unique in the world. The inhabitants interact with it, taking possession of the place and the landscape they live in. Kevin Lynch, in “The image of the city” (1984), explains how an *effective environmental image* orientates the inhabitant, providing him or her with emotional security. This explains the importance of the existence of elements of reference in the landscape, such as the Alhambra monument, the city and the fertile plain or *vega*.

But these topographic gradients characterise the area and make viewpoints possible, those of a more fragile nature. Any inclusion off-scale could mean an exogenous and overwhelming element. An analysis of its silhouette, texture and border therefore acquires importance.

Its silhouette is defined by two elements: a surrounding line that often becomes blurred with the topography; and its protruding elements, vents and chimneys, which mark a rhythm that alludes to the anatomy of the setting. On other occasions, this line is perceived as a white fringe made up of limestone façades (Figs. 2 and 3).

The texture of the landscape at this scale is uniform; the caves blend into the vegetation.

The border is made up of the landscape itself, the morphology of the land.

For the work at the third and final scale, the detail, the public space of the Cuevas del Sacromonte Museum has been analysed.

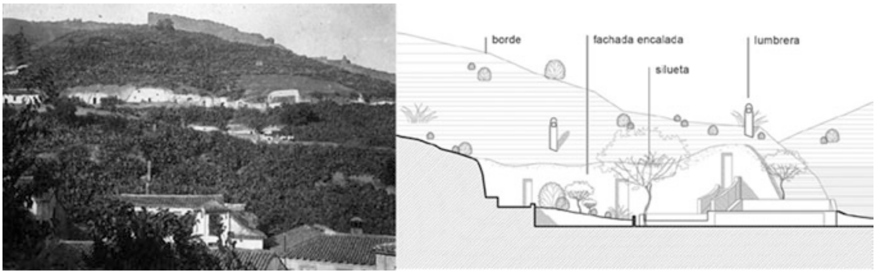

Fig. 2 Different elements that characterise this settlement. Riches, Paul. (1903) *Quartier Des Gitanes* [*Photograph*]. Board of the Alhambra and Generalife. Recovered from: http://www.alhambra-patronato.es/ria/handle/10514/13487?show=full. García, A. and Medina, K. (2015) *Sección* [*Section*]

Fig. 3 Pérez Pulido, Laura and Dávila Ponce de León, María Jesús. (2014) *Análisis Semántico* [*Semantic Analysis*]

Dialectics between the different elements that comprise the environment are sought. The search for dialogue between elements of a different nature, such as vegetation and buildings, near and far elements, is stimulated.

In this type of settlement, public space is formed by a number of plateaus, marked by a strong position of identity. In these areas, the gradients are moderate, forming an area of level ground that differentiates it from the rest of the complex, becoming natural balconies towards the Alhambra (Fig. 4). They are areas with great views and whose spectacular vantage points have made this landscape unique, in turn blending into the private space, dissolving its limits.

The creation of a digital model of this space allows us to carry out a formal analysis and make visible important elements in the assessment of the habitat and the sensations provoked.

Daily life can be appreciated in the *plazas* or squares. We identify it as an *open private square*, Gordon Cullen (1974, 98). Its domestic scale, in a quiet neighbourhood far from the city, in a natural landscape and in which a transition between

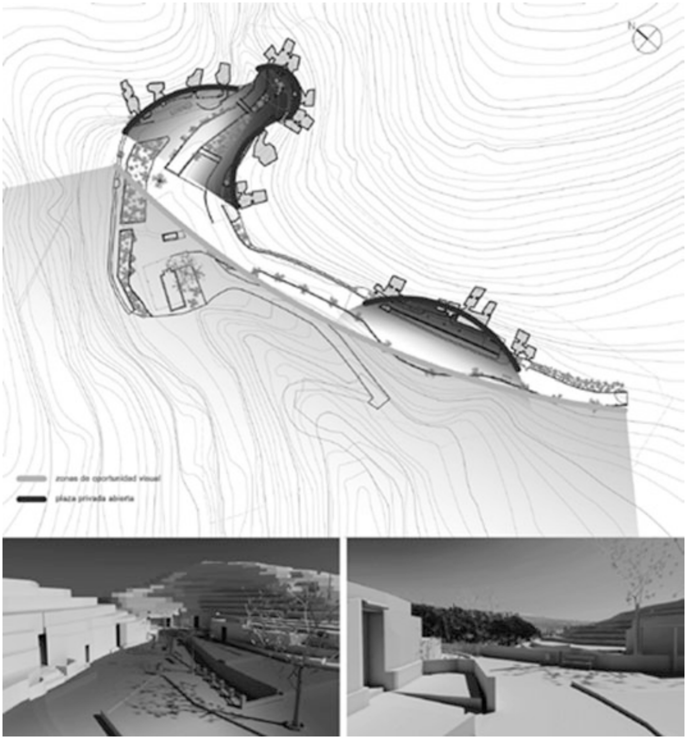

Fig. 4 García, A. and Medina, K. (2015) *Esquema en planta y fotos de maqueta de la placeta.* [*Diagram and mockup photos of plateau*]

Fig. 5 García, A. and Medina, K. (2015). *Vista de placeta* [*View of plateau*] 18th century print (1985) *Cueva Del Sacromonte* [*Sacromonte Cave*]. [Print] Board of the Alhambra and Generalife. Recovered from http://www.alhambra-patronato.es/ria/handle/10514/309?show=full

Fig. 6 García, A. and Medina, K. (2015) *Fotomontaje dualidad intimidad-libertad* [*Photomontage privacy-freedom duality*]

nature, public and private space is produced (Fig. 5). The open space becomes an enclosure, its inhabitant feels identified, and detail can start to be perceived, together with elements arising from human activity.

Domestic functional utensils acquire structural fortitude, drawing the observer's attention and becoming ornamental elements over the land. A land whitewashed and with a purpose; to shelter and protect its inhabitants. When one accesses this type of hypogeum, the sensation is of enclosure and seclusion in the interior, but upon going outside into the landscape the sense of freedom felt by inhabitants is reaffirmed (Fig. 6).

Erosion and the passing of time increase the expressiveness in the textures. Dirt is deposited in the exposed higher surfaces, provoking a lighting effect from below that dramatises the details. The hidden structures start to show. The rain scratches the surface. There is an increase in the differences in tonality and grain. All of these details tell a story (Fig. 7).

Fig. 7 García, A. and Medina, K. (2015) *Fotografías de texturas* [*Photographs of textures*]

5 Conclusions

This work is a sequential study of the place in order to know it and understand it as an interactive system, where the fundamental characteristic consists in nature, more than a setting, being the main component of the scene, defining its visual structure.

There is an attempt at creating a series of guidelines for future analyses and interventions in cultural landscapes with great historical and morphological importance.

- *The landscape* is constituted with the action of the society on the physical media that it inhabits, to which historical changes come about thanks to those who are able to establish the first stages of its creation and evolution.
- *Preserve* does not mean maintain; there must be evolution in accordance with new social demands, in a balanced and harmonious way, where the values obtained are continued and others can be added. This means understanding, valuing and respecting the surroundings and the genius loci of the place.
- *The relationship between humans and nature* is not resolved with the former using nature as a pretty decoration for their lives; it must be considered as protection and origin; it must be learnt from and, above all, rediscovered as a source of meaning in itself (McHarg [1992] 2000).
- *Places are dynamic, they have a function and development.* The study of these is crucial to a harmonious evolution amongst the different elements that compose and identify them. Via research and experimentation we can find keys to avoid their transformations being traumatic, and for them to come about in a balanced way. It is fundamental to live them through looking, walking, smelling, touching, listening…

– *Architecture should show itself to be intrinsic to the place*. There should be a total integration within the natural structure of the landscape and the creation of a complete environment to be experienced and lived in by humans.

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Drones for Architectural Surveying. Their Use in Documenting Towers of the Valencian Coast

Pablo Rodríguez-Navarro, Teresa Gil Piqueras and Giorgio Verdiani

Abstract We continually hear about the virtues of the use of drones, but not about the real possibilities of the existing ones in the market applied to the work of architectural survey; and neither about the advantages and problems it solves in the incorporation of aerial photographs in the photogrammetric survey, covering topics such as the necessary software, turnaround times, the accuracies achieved or costs …. Additionally, there is a legislative part which is necessary to highlight, so below we have also summarized the legal and facultative needs to perform these work as established by AESA (We use the word drone (drones in plural) because it has been recorded in the 23rd edition of the Dictionary of the Royal Spanish Academy, meaning unmanned aircraft. It can also be referred to as a UAV (Unmanned Aircraft Vehicle) or as the Spanish Aviation Safety Agency, has recorded it RPAS (Remotely Piloted Aircraft Systems)).

Keywords Drone · Architectural surveying · Documentation

1 Introduction

In recent years, improvements in autopiloting software of drones (RPA under current legislation), has opened new perspectives to the use of aerial photography and video. This "revolution" is facilitating numerous applications in various fields, whether scientific, professional or purely entertainment.

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In the field of architecture, and more specifically, in architectural survey, this new possibility of obtaining photographic views until recently unthinkable, has coincided in time with another breakthrough in the field of photogrammetry: the discovery of new algorithms that have automated the process of 3D photo modelling, known as the SfM system (Structure from Motion), which allows getting very reliable 3D models and photorealistic textures based on a photographic sequence.

This communication aims to present the current state of existing technology in the market regarding drones, analyse the advantages of their use in our area of expertise and finally review the current legislation necessary to make use of it. To achieve this objective we will present the applications that are being carried out in the frame of the R&D project entitled “Watch and Defense Towers of the Valencian Coast: Metadata and 3D Models Generation for Their Interpretation and Effective Enhancement” (HAR2013-41859-P), funded by the Ministry of Economy and Competitiveness.

2 The Boom of the Drone

There are technological advances that become fashionable and act like an invasion. Usually they are accompanied by a series of comments that bring us closer to fiction than to reality, and even more today, if we were told to travel back in time we would reply: it has been Google, right? We would be more concerned about who got it than to know whether it is really possible or not.

We have heard that drones have been used since the mid-twentieth century, and this is true somehow, although from my point of view this is the first mistake; at that time, the first military drones were used but those devices were far from what we may be interested in. Military drones are like fighter jets operated from the distance, with part of their flights scheduled. The famous “MQ-1 Predator,” to name one of them, needs a staff of 55 people for a mission, weighs a ton at take off, carries two missiles and costs more than 3 million USD, still far from the top model, the Global Hawk, which costs 15 million.

Quite different are the drones used by civilians, which in any case are model airplanes that sometimes incorporate a camera or any other component susceptible of being controlled from a distance, utilised most commonly as a hobby or a sport internationally recognized since 1936.

As a matter of fact, there are model airplanes with wing configurations, i.e., like a small plane, as is in use by the military, but very light weight and reduced in size, which have been used for cartographic flights for many years. But the revolution has come from the hand of the multirotor drones, which are capable of maintaining a static position in flight, requiring minimal space to manoeuvre.

To understand what has happened to these model airplanes that have been among us so long and suddenly have taken this role, we can draw a parallel with another piece of technology such as the mobile phone. What has happened to our phones converting them into smartphones in such a short period of time? Perhaps something similar to what happened to my model aircraft which is now a drone. Technology has advanced and the first phones incorporated cameras and subsequently GPS; then they were connected to the data network, the size of gyroscopes and digital compasses was reduced achieving increased accuracy at the same time, and batteries improved, passing through the nickel-cadmium (NiCd) or nickel metal hydride (NiMH) ones to finally reach the well-known LiPo (lithium polymer) that can provide twelve times more power than their predecessors.

If we go back just a few years, we can remember the small radio-controlled helicopters that were in every toy store and that every child had to have. This was a first step and incorporated the technological developments, although it was certainly the advances in software of the autopilot, which is how the electronic unit for the control and administration of these model airplanes is known, coupled with the same elements incorporated to smartphones (GPS, gyroscope, digital compass…) which have materialized the dream: to have the technology to make a small and lightweight multirotor drone, with all these aids, which make that anyone can operate it. Such is the dependence on these systems to fly, that if an inexperienced pilot lost the GPS signal (which makes the drone remain in a fixed position and, in case of "panic" of the pilot, he can order the drone to return home in an automatic mode) he would surely lose control and his remote vehicle may encounter a dramatic finish.

3 Drones Available on the Market Today

There is a tendency to put all existing non-military drones in the current market into the same basket, but it is a mistake that often costs money to those starting in this field. A basic classification is needed to put our expectations into place, so the first division would be between fixed-wing and multirotor drones. Additionally, each of these two classes can be divided into three categories: children's toys (indoor flight), recreational drones for adults (model aircraft club) and professional drones (for licensed pilots).

Non-professional fixed-wing or model airplanes are the best known to all and, in the professional field, as discussed above, are used for cartographic surveys. We will not look deeper into this type of drone because it does not directly affect the architectural survey and, also, because field surveys of not very extensive areas are made with multirotors as well. Nonetheless, we name a couple of models with these type of wings which are highly valued professionally: the Sirius Pro Topcon and Trimble UX5.

As for multirotors, we can clearly distinguish the home toy drones which, though usually provided with a webcam that records onto a memory card, do not have electronic aids for outdoor flights nor can support the weight of any camera as small it may be. However, in the category of recreational adult drones, uses are being intermingled, causing harm both to the user and to the professional sector. I am referring to the very well known and varied DJI Phantom or Parrot AR. Drone models. These relatively inexpensive models (between 500 and 1000 euros), light and very easy to use, can mount a small camera like the famous GoPro (74 g) or carry a fixed camera placed by the own drone manufacturer. These lightweight drones are not suitable for professional flight, carrying cameras of absolutely insufficient quality, not allowing to replace them, and above all, with a size and power which makes them very vulnerable in flight to meteorological complications. Unfortunately, although we will address the legal issues later on, we anticipate that AESA does not distinguish between more or less professional models.

Working with professional multirrotor drones is quite different; the pilot realizes he has to check all the materials before the flight, following strict protocols which are closer to the world of civil aviation than to model aircrafting. He must check the weather forecast, record hours in an engine's log book (for those pilots that keep it), and then follow a protocol before starting the flight which includes review, calibration, temperature controls, command sequences, etc. And it all makes sense when the flight begins. In today's marketplace we can find professional multirotor drones from the best measurement instrumentation companies such as Leica Geosystems AIBOT X6 or Trimble's ZX5 and others like Dragonfly UAV. The price of these devices is still very high, exceeding in most cases the latest generation of 3D laser scanners. However, there is a much more economically viable possibility, which also allows to significantly adapting the drone to a specific job; I am referring to those companies approved by AESA engaged in the design and assembly of professional drones. These drones would be comparable to cloned computers, i.e., bespoke but using the same technology and components as the "branded" ones. The result is the lowering of the price which is reduced four or five fold, a better adaptation to our specific needs, possibilities of renovation and improvements, and, in many cases, superior after-sales service.

In the near future, it seems like very powerful multinationals, like Japan's Sony or similar, intend to enter this professional market for photography and video drones, according to their own statements, which will surely completely change the current picture.

4 Contributions of the Use of Drones

The fundamental contribution of drones to architecture is the ability to position ourselves as a spectator anywhere we want, enabling us to experience new perspectives unthinkable until now. However, once there, we can perform different actions that depend on the tool you have placed in it. The most common will be a quality camera that can both take snapshots and video clips. It is also very common to equip drones with full spectrum cameras, such as thermal imaging cameras (infrared). Finally, thanks to the positioning accuracies being achieved, 3D laser scanners can be incorporated as well (Fig. 1).

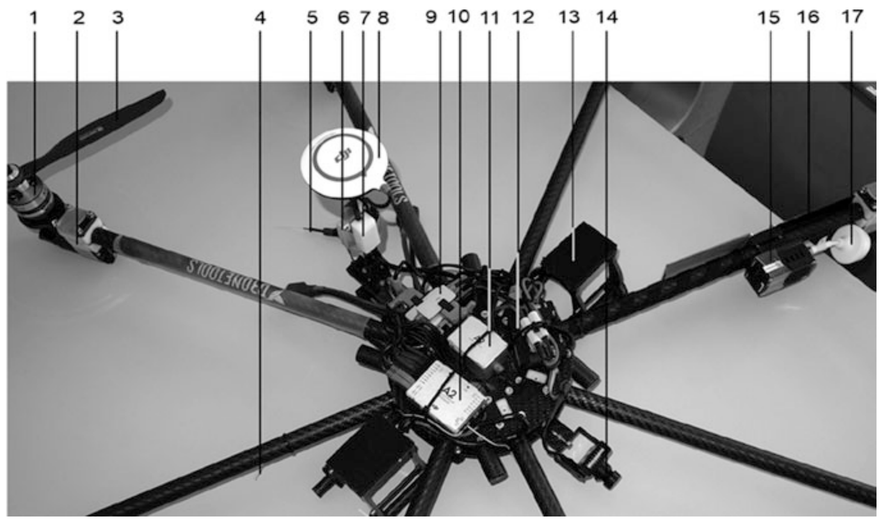

Fig. 1 Components of the drone. *1* Engine, *2* drive, *3* propeller, *4* emitting antenna, *5* modem antenna, *6* status LED, *7* bluetooth transmitter, *8* GPS antenna and magnetometer, *9* 2 digital and power buses, *10* CPU, *11* IMU (3 accelerometers, 3 barometers and 3 gyroscopes), *12* black box, *13* battery holder, *14* pilot chamber, *15* FPV transmitter, *16* nameplate, *17* video antenna

The possibilities of both video and photography for the promotion, dissemination, monitoring, etc. in construction are well known, incorporating now a new attraction with the capabilities of choosing points of view differing from the usual ones. Also, with the inclusion of a scanner, problems associated with obtaining data on roofs and other inaccessible points are resolved, although it may still be a questionable investment and inherent risk in comparison to the problems it solves.

However, simple photographs taken with the drones are representing a very large contribution to the three-dimensional architectural survey, thanks to the coincidence with the maturity and advancement of photogrammetric systems based on machine-vision processes. Just as photogrammetry seemed overtaken by active measurement systems, it has made a strong comeback standing at the head of the most profitable systems for documenting the architecture (Rodríguez-Navarro 2013) (Fig. 2).

5 3D Photogrammetry. SfM Photomodeling

It has been more than 20 years since companies like Eos Systems Inc. have been offering us software, such as the well known Photomodeler, in order to obtain 3D models from photographs. However it has been in recent years when photomodeling advances have been remarkable, mainly due to the development of new algorithms that have facilitated the production of three-dimensional models using

Fig. 2 Dronetools quadcopter drone

the method called SfM (Structure from Motion), although it is true that without the significant increase in computing power of multi-core processors coincident in time, its application would not have been possible (Wu and otros 2011). This method is based on the phenomenon by which three-dimensional structures can be reconstructed from 2D images due to changes showed by the elements when the point of view of the observer changes.

The images used are conventional, made in principle with any camera, from any point of view, but keeping with the maxim that all parts of the model are visible at least from three different points of view. The process is based on automatic identification of homologous points in different shots, requiring previous calibration and orientation, which is also done automatically.

On the market they are appearing multitude of software based on this system. We can find some free online service software, like Autodesk 123Catch, free software, like Visual SfM developed by Changchang Wu (2013), software developer at Google, or Apero-Micmac developed by scientist Marc Pierrot-Deseilligny in the MATIS laboratory of IGN France, much more accurate but less intuitive than the others previously mentioned. As for the software, the first to outstand was the Russian company Agisoft with its well-known PhotoScan, although there are many others of the same reliability, such as Acute3D, Arc Tron 3D, Pix4Dmapper, …. It

Fig. 3 Photomodeling process by SfM and digital 3D modelling

seems that the introduction of large software companies will give it the final impetus, highlighting Autodesk today with its ReCap package, an intelligent application to create and integrate advanced 3D models (BIM, AEC, MCAD) from information either scanned or captured from photographs.

When working with this type of software, the first thing that needs to be done is the alignment of the pictures that will be used to rebuild the model. This is done automatically and includes calibration and correction of all images based on their automatic analysis and exploiting their EXIF data. The procedure is based on the use of contrast pixel of the image as a form, looking for homologous elements in all the pictures and thereby the relative positions of each camera.

The set of camera positions, along with the pictures themselves, are used for the next phase, which is the construction of the model's geometry, i.e., the construction of a 3D polygon mesh defining the model's surface. Finally, we can automatically create the photorealistic texture for the 3D model (Fig. 3).

6 Case Study. Aerial Photography for the Valencian Coast Watchtowers Elevation

When we started developing the R&D project entitled "Watch and Defense Towers of the Valencian Coast: Metadata and 3D Models Generation for Their Interpretation and Effective Enhancement" (HAR201341859-P, funded by the Ministry of Economy and Competitiveness), we proposed to determine the methodology for the graphic elevation of this building corpus. The use of 3D SfM photomodeling was selected as one of the best methods both for cost and time saving reasons and for the quality of its results. The Achilles' heel of this system is found in models with uniform tones, such as clear skies, glass or polished surfaces, creating digital artefacts due to the difficulty in identifying homologous points with needed accuracy. In towers elevation we encountered this problem primarily with skies and, although it can be avoided with the use of masks, the process is very laborious.

This was not the only problem posed by this system, encountering some added difficulties arising from the morphology of the building itself, which we solved by implementing alternative methodologies. These problems were:

– Access around the entire perimeter of the tower to take pictures.
– Access to the cover and flown elements to be photographed.
– Need to mask all the photographs capturing the sky.
– High difficulty or impossibility of photographing interiors (due to lighting problems) and constricted spaces (such as narrow staircases).

Using a drone for shooting the photographs solves the first two accessibility problems listed above. Aerial photographs allow us the freedom of movement needed to take pictures from every point of view that we deem necessary, including areas that cannot be accessed otherwise.

Furthermore, if we use the same camera for a terrestrial photographic sequence, we can proceed to do photomodeling without masking the sky, solving the third problem above mentioned.

For this project we used two drones manufactured by Dronetools, a quadcopter (quad) and an octocopter (octo). There are two fundamental differences between them: the quad is handled by a single operator who acts both as pilot and camera operator; while the octo requires a pilot and a camera operator, who will make use of his own command to operate the camera. Obviously, the quad has a lower elevation capacity, so it carries a lighter camera (Fig. 4).

The camera used in the quadcopter is the Sony RX100 II, with a 20.2 MP resolution, a 13.2 × 8.8 mm. CMOS sensor and Zeiss F1.8 lens with 28–100 mm focal length. The camera used in the octocopter is the Sony α7R, with a 36.4 MP resolution, full frame CMOS sensor and ZEISS f4.0 lens with a 24–70 mm focal length.

The choice of camera is given by the distance from which the shot is made since it is advisable, in order to achieve a good result, trying to capture as much of the object as possible. Thus, with larger towers featuring annexed constructions, the drone shoots from a further distance and a higher resolution camera is used.

But more aspects influence the choice of the drone, such as the forecasted wind speed or whether we have a camera operator or not.

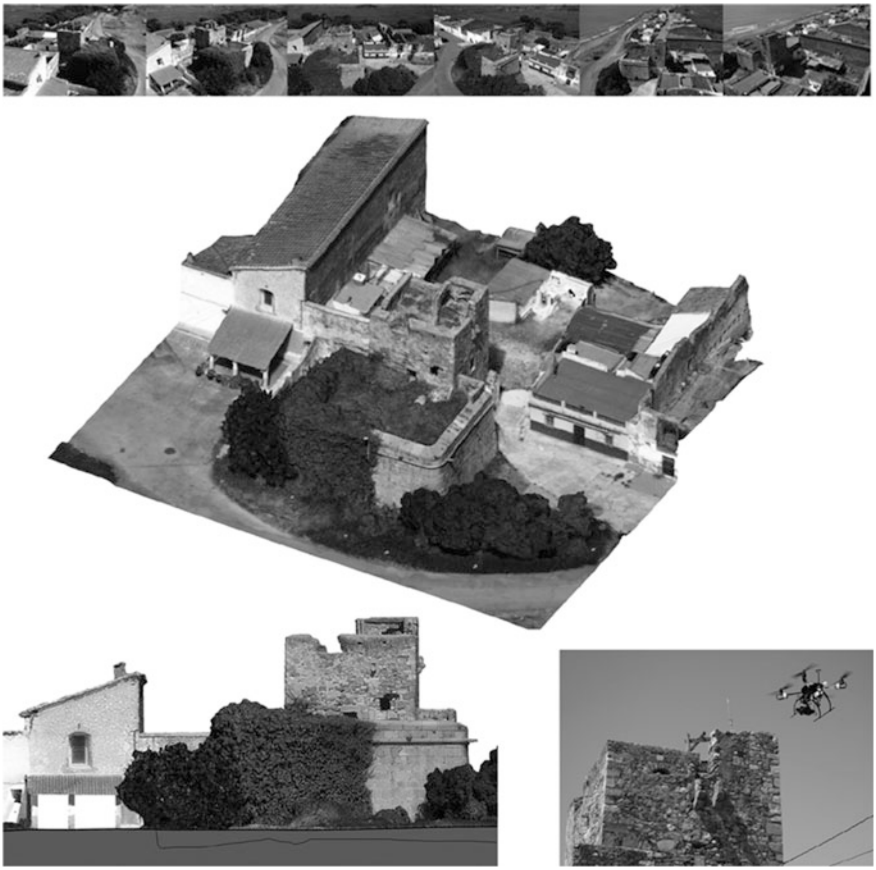

Fig. 4 Photographic sequence, 3D digital model, dihedral view. Drone with four rotors

7 Legal Constraints and Facultatives in Spain

On July 4, 2014 Royal Decree-Law 8/2014 on the operation of remotely piloted aircrafts, called drones, of less than 150 kg at take-off was approved. It established the exploitation conditions of these aircrafts to carry out technical and scientific works. That legislation has been published in the Official Gazette as Law 18/2014 dated on October 15th 2014. The regulation is defined as temporary and also includes compliance with the general scheme of Law 48/1960 of July 21st on Air Navigation. A summary of the most interesting aspects of this legislation is presented here, which is not intended to collect the totality of the law and procedures, to which one should refer in any case (Fig. 5).

Regarding the identification of the drone, if its weight exceeds 25 kg it must be registered and have a Certificate of Airworthiness as any other civil aircraft. If it

Fig. 5 Eight-rotor drone. Completing the list of verification prior to transport to the place of flying

weights less than 25 kg it must have a nameplate affixed to its structure that shall state, in a legible to the naked eye and indelible manner, the identification of the aircraft, by specific designation and, where applicable, the serial number and the name of the operating company and the data necessary to be contacted. These drones of less than 25 kg, which are those we would need to use for our area of expertise, are in turn divided again according to their weight: under 2 kg. and less than or equal to 25 kg. Both have to be flown with constant visual control and distance limitations: maximum altitude of 120 meters and a maximum distance of 500 meters. In the case of drones of less than 2 kg the distance may be increased over 500 meters if they have a NOTAM,[2] i.e. an express authorization of their flight program which in turn is communicated to other aircraft using the same airspace.

In addition, to operate drones we will have to meet the following requirements[3]:

- Documentation of the drone: settings, features, benefits.
- Operations Manual setting out the procedures of the operation.
- Aeronautical safety study of the operation.
- Have successfully completed test flights.
- Availability and fulfillment of the drone maintenance program as recommended by the manufacturer.
- Have an insurance policy for aviation liability issued by an insurance company authorized by the General Directorate of Insurance in the field of civil liability of aircraft.

[2]A NOTAM, acronym for Notice To Airmen, is a message containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential for the systems, equipment and personnel responsible for flight operations.

[3]It is necessary to know the following terms: "Operator" or free professional company carrying out the work; "Operation" specific work for which it has been authorized, such as aerial photography, photogrammetry, surveillance, …; "Flight Test" flights done to test the operations for which the operator will devote the drone being requested authorization for.

– That appropriate additional measures are taken during operation to ensure the safety of people and properties.
– The operator must have a pilot license or have had it in the last five years. Otherwise he must have the certificate of pilot of civil remotely piloted aircraft, issued by an organization officially approved for that purpose requiring the pilot to succeed at a theoretical exam[4] and a practical flight test. In addition, all pilots must dispose of the document certifying that they have the right skills and knowledge specific for the drone model they will use, and the operating thereof, issued by the manufacturer.
– As for the flight limitations, are set as prohibited areas those within 8 km from an aerodrome or 15 km in the case of a towered airport. It is also prohibited to overfly populations or outdoor crowds of people.

8 Conclusions

The use of drones for the architectural survey appears as a necessary tool in many occasions. Thanks to the freedom of movement of the drone we are able to visually move around the building complex, and with the aid of 3D photomodeling software it is possible to convert these photos in 3D digital models, usable at different scales, with high accuracy and a realistic texturing.

Right now we have to follow a series of strict regulations for these activities. However, a significant change is expected in the next months, when the new European legislation will be approved.

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New Survey Methods for Graphic Documentation of Architectural Heritage: The Remains of the Walls of Santo Domingo de La Calzada in La Rioja (Spain)

Licinia Aliberti and Pedro Iglesias Picazo

Abstract Photogrammetric reconstruction systems continue to refine new methods that allow automatic reconstruction of complex objects using standard tools. Nevertheless it is essential to control the data collection techniques and conditions, as well as the management of the data itself, in order to have a proper use of these powerful tools. This paper presents the results of the photogrammetric reconstruction of some sections of the Walls of Santo Domingo de la Calzada in La Rioja (Spain), aiming to link with the current research on the evolution of architecture representation methods, with a particular emphasis on the documentation of heritage.

Keywords Photogrammetry · Automated systems · Architectural heritage · Santo Domingo de la Calzada

1 Introduction

The recent progress of the techniques of photogrammetric survey brings together a research in new ways of graphic representation on architectural heritage. Digital photogrammetry allows a large distribution and provides high quality accuracy with low cost tools, in opposition to 3D laser scanner (Rodríguez Navarro 2012). The introduction of sophisticated mechanisms for the creation of point clouds and continuous surfaces allows the reconstruction of complex objects using standard tools. Nevertheless it is essential to control the data collection techniques and conditions, as

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well as the management of the data itself, in order to have a proper use of these powerful tools.

The main goals of this research are to apply the method to a specific case study, to compare the restitution of objects with different form features and to verify the automated photogrammetry as an efficient method for the archaeological remains survey and architectural heritage documentation.

This paper presents the results of the photogrammetric reconstruction of some sections of the walls of Santo Domingo de la Calzada in La Rioja (Spain). The work is part of the studies for the drafting of the Master Plan of the walls promoted by the Cultural Heritage Institute (IPCE), under the Spanish Ministry of Education, Culture and Sport. According to the evidence published to date the conserved sections of the walls were built between the 14th and 15th century (Álvarez Clavijo 2013; Azofra Agustín 2005), however they could include constructions of a previous period or modifications realized in a later age. The study of all conserved walls is driven by an increasing interest about the defensive constructions as elements that organize the urban space and show cultural values. This new consideration of the walls allowed to look at them not as an obstacle to the city growth but as an important identity frame. The detailed graphical documentation of the walls' current state is central within this context, since it isn't present in the scientific publications up to date.

In order to draft the Master Plan, a complete restitution becomes necessary. The work includes all conserved sectors, with the aim to document their shape, dimensions and current state of conservation. In this paper we selected some of these sectors to set a comparison of the results of the surveys and to offer some contributions about the applied method (Fig. 1).

Some of the conserved remains are nowadays integrated into the urban fabric as visible or hidden elements. There are some cases where the entire wall or towers are

Fig. 1 View of one sector of the walls conserved

Fig. 2 Location map of the north-west sector of the walls located in the old town

conserved. In the North-West part of the ancient town we find one of the best preserved sectors. Next to this area it was located the main access to the urban centre through the so called "Puerta de Barrio Nuevo" or "de la Rúa Mayor" (Álvarez Clavijo 2013). It was located at the West end of the "Calle Mayor", where the "Camino de Santiago" leaves the urban area. North-West sector shows a set of 4 towers and 5 stretches of the walls. These parts are almost fully visible from outside, while there are many adjoining constructions inside. The towers rise from the walls alignment in a limited extent and they are open in the inner side. The stretches of the walls present different states of conservation and in some cases they have doors and window openings or blinded hollows. There are different materials and the most clearly identifiable are *calicanto* (stone and lime), mud wall and brick. The upper part of the walls is irregular due to the loss of the original crenellations and there are zones where these parts are hidden by the vegetation. This conditions make difficult the true identification of the entire surface.

The Municipality of Santo Domingo de la Calzada realized the restoration of some of the towers and walls sectors generating a renovation and a new interest thorough the conserved remains (AAVV 1994).

This specific work focuses on the graphic reconstruction of six parts of the North-West sector, that include three towers and three stretches of the walls. The first six parts that present a similar state of conservation were included, while the first restored tower located in the North-East corner of the walls remained excluded. This selection defines a precise area of research and helps to compare data in objects with similar features but different shape (Fig. 2).

2 Survey Method and Research

The research develops subsequent steps of data collection, processing and management of results. The approximation to the building dimensions and shape increases due to the use of different techniques and the integrated software of photogrammetric reconstruction and vectorial drawing. Together with the photos collection we identify a series of reference points by using a total station. In this way we have useful data to orientate and scale the models and to join them in a common reference system. Moreover the data collection includes the direct measuring of some parts of the walls with a laser distance meter. The description of tools and techniques used to perform the reconstruction is important to faithfully document the work and the obtained measures. This is a required condition in every architectural survey (Almagro Gorbea 2004).

The data processing is based on the selection of the information needed to obtain the graphic reconstruction of the walls. One of the new challenges of current survey methods is the research of a correct transition between the point clouds and the continuous elements like lines and surfaces (Canciani et al. 2013). These are key tools in architectural studies. This work aims to link directly with the current state of research on the development of survey methods and architectural representation, with particular reference to the documentation of architectural heritage.

The use of automated photogrammetry is in an increasing process in the metric and graphic reconstruction of architectural and archaeological heritage. The functionality of this system allows operating with unfavorable conditions and pursue the accuracy of the measurement with the use of low cost tools (Robleda Prieto and Perez Ramos 2015). The photographic camera is easy to transport and its application to drones allows to complete the data collection realized by terrestrial laser scanner that use to present problems of shaded areas (Di Tondo and Fabrizi 2013).

In the past few years photogrammetry was not able to rise the detailed information generated by three-dimensional laser scanner, but the current development of new procedures and low cost software increased greatly the possibilities of this method. Software like Autodesk123D Catch, ARC3D or Agisoft Photoscan allow to obtain results with a high level of detail and measuring approximation, so that they can be compared to laser scanner. Two disciplines combine to generate these systems: the artificial vision, that allows the identification of photographic images and their processing in order to construct three-dimensional models, and the photogrammetry that aims to obtain a faithfully metric reconstruction of the objects.

We realized the alignment of photographs and the identification of raised points using the automated photogrammetry. These operations produce the construction of three-dimensional point models and high density point cloud conserving chromatic features. The point cloud obtained fully registers the irregularities of the different parts of the walls. This method is specially useful for the reconstruction of archaeological remains and buildings with ruined elements or irregular shapes. The case of the walls of Santo Domingo de la Calzada belongs to this category, especially regarding some of the sectors which are in a high state of disrepair.

We realized the data collection during three different sessions, that were alternated with desktop work to process the information. In order to obtain a correct reconstruction it is crucial the quality, quantity and framing of photographs. Despite the progress of automated proceedings, part of the accuracy of the results depend on the critical and interpretive work of the operator (Nocerino et al. 2014).

Considering the importance of photographic images, we want to emphasize the quality of the camera used to realize the data collection. The photographs were made using a digital reflex camera with CMOS sensor 35.8 × 23.9 mm and fixed lens that were exchanged as needed. Part of the photographs were taken using a 50 mm lens and part with a 24 mm lens. In both cases the camera sensitivity was set to ISO 125, due to the favourable lighting conditions of study objects (Fig. 3).

We collected the photographs realizing a series of front photos from an approximated distance of 5 to 6 m from the surface. The images present large areas of overlap in order to allow the point rise in different photographs. We generated the same kind of series from a greater distance. Afterwards, other photographs from different distance and angle were taken. The series of each sector includes vertical and horizontal photographs, which use to make easier the alignment of images and the photogrammetric restitution.

A specific software for the photogrammetric reconstruction was used in order to obtain the three-dimensional models and other CAD software for vectorial drawing of graphic restitution. In this case we used the software Agisoft Photoscan Pro for photogrammetric reconstruction. It allows a sequence of operations and high developed automatic proceedings and helps to control the specific settings that guide the reconstruction thorough the kind of results intended by the research.

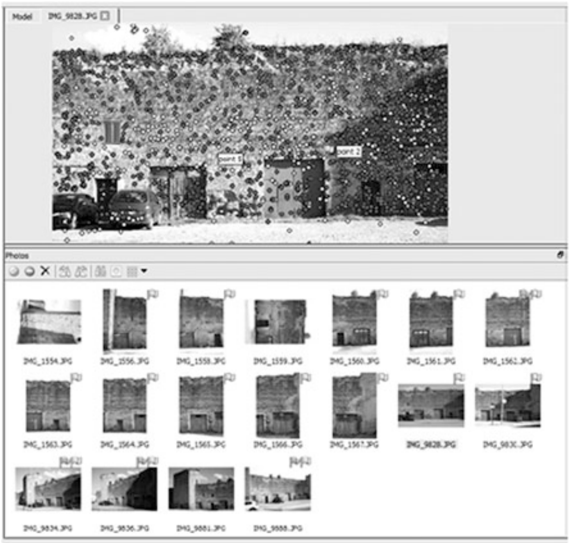


Fig. 3 Photographs used to generate the reconstruction of one sector of the walls; view of raised points and some reference points (GCP)

The photographic material was selected and organized in a set of photographs for each sector of walls or tower. Data were proceeded with standard tools, so that it was necessary to study the different parts in separate steps in order to obtain high definition models with an easy management of information (Fig. 4).

Camera calibration was realized automatically during the alignment and identification process of images. The proceedings applied by Agisoft Photoscan Pro have been tested and ensure an excellent calibration of the camera (Ippoliti et al. 2015). This automatic calibration is here applied after verifying the correct coherence between one first photogrammetric model and some reference measurements registered with a laser distance meter.

The images were aligned and a three-dimensional model was obtained through the software. The proceeding time changes according to the size of the study object and the number of photographs used. The survey of towers presented some difficulties due to their shape, in which the reconstruction of the three visible planes in a single model required a greater number of photographs with oblique views of the surfaces. This enables the complete recognition of the towers' corners in a larger number of images to link the reconstruction of different surfaces in one single model.

We scaled and orientated the models by using the reference points registered with the total station, which are usually named GCP (*Ground Control Point*). We selected some identifiable and clearly visible points into the photographs, so it was possible to relate the position of these points with the restitution model. The reference points' coordinates are georeferenced in order to allow the introduction of models into the general topographic information of Santo Domingo de la Calzada.

We applied automated proceedings SFM (*Structure From Motion*) to the tie points model and we obtained a high definition point cloud that includes its chromatic information. The approximation of the dense cloud to the building shape depends from the accuracy of photogrammetric model created through the alignment of selected photographs. To have a correct use of a dense cloud it is useful to

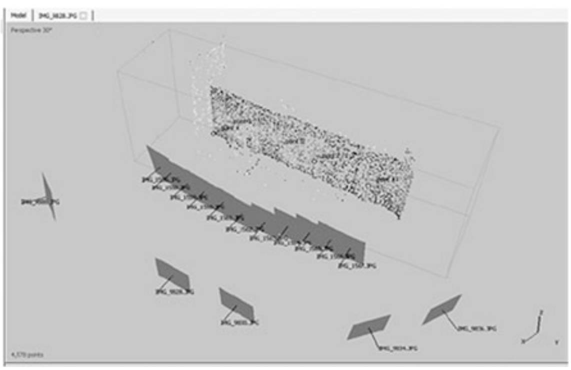


Fig. 4 Example of the reconstruction of one approximately rectilinear sector of the walls. View of the point model created with the alignment of photographs (*Tie Points*)

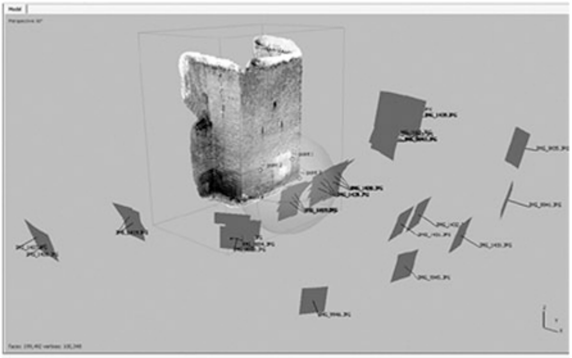


Fig. 5 Example of the reconstruction of one tower. View of the photographs used and the point cloud obtained (*Dense Cloud*)

Table 1 Summary table of the principle values registered during the restitution process

Section	Approx. length (m)	Approx. height (m)	Photo camera	Camera lens (mm)	N. photos	N. GCP	Tie points	Dense cloud
01	28.3	8.4	EOS 5D	50	18	5	4.578	529.520
02	6.1–8.2–6.1	13.1–13.8	EOS 5D	50	30	6	5.492	642.235
03	24.8	8.2	EOS 5D	50	18	4	4.740	760.962
04	3.5–8.0–3.1	7.9	EOS 5D	50	20	5	4.983	437.928
05	23.6	5.8–7.4	EOS 5D	50	19	4	6.560	605.552
06	6.6–8.4–6.6	12.6	EOS 5D	50	41	4	8.771	725.333

polish it from unnecessary elements, since the software reproduce all objects identifiable in the images (Fig. 5).

Some of the values of the sectors of the studied walls are documented in the following Table 1. We attempt to relate the objective features of each sector with the derived information from data collection and part of the reached results. The number of points of the tie points model and of the dense cloud include part of the urban context set around the study object. We didn't apply the mask tool directly to the photographs because of the irregularity of the walls edges, specially evident in the upper part. During the polishing work of the point dense cloud it was possible to minimize the presence of obstacles in the field of vision, while part of the surrounding environment was conserved.

Because of the large dimension of the study object and the use of a standard computer the models were processed to build a dense cloud in a medium density level, while the software can generate a huge quantity of points by interpolating the coordinates of the first tie point model. However, considering the requested accuracy and the context conditions, the quality obtained was completely suitable for the development of the research. The models have a high accuracy level and they can be easily managed with specific software.

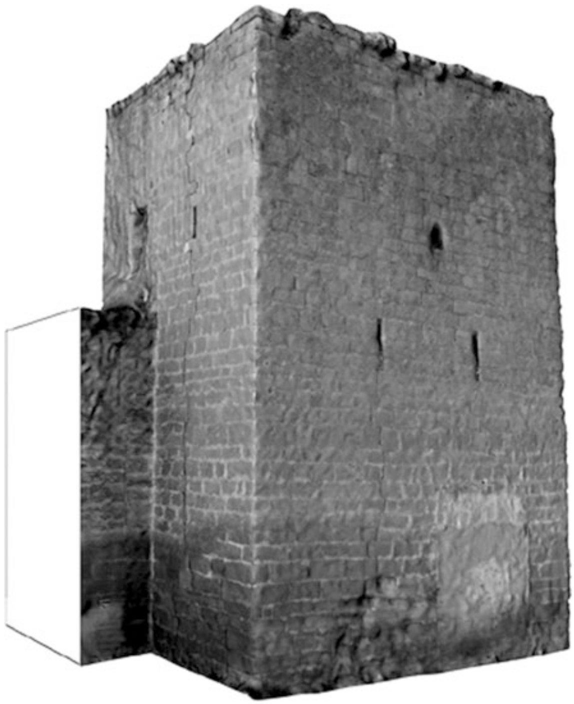


Fig. 6 Reconstruction of one of the towers. Perspective view of the textured mesh surface

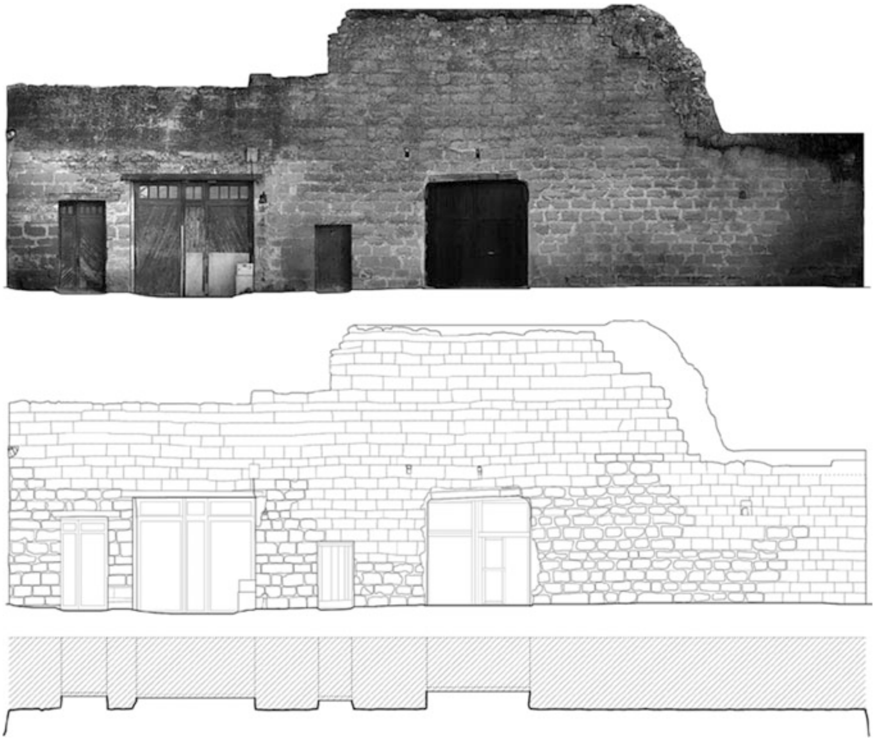
The creation of a continuous surface from the point cloud allowed to build a three-dimensional model editable with vectorial drawing software. The triangulated surface "mesh" keep both the volumetric features of the building and the data related to the current state of conservations of the surfaces (Fig. 6).

Vectorial drawing software can import the triangulated surface and exploit it to obtain the graphic restitution of the object. An essential work was to extract horizontal and vertical sections in order to obtain the architectural representation of the studied sectors of the walls.

Bi-dimensional drawing of plans, elevations and sections is considered relevant in this work. It offers graphic documentation which describe in detail the shapes of the walls, the cutting of materials and the elements that were added to the original structures. With this aim we introduced the use of ortophotos which complete the information derived from the restitution model. The projection plan of the ortophotos was defined by the reference points that were previously used to scale and orientate the models. In the specific case of towers a larger amount of points were defined in order to extract the information of each plan of the building. The ortophotos quality is excellent due to the high resolution of photographic images that were used to obtain the restitution. Only when there were obstacles next to the surface the final image shows some loss of definition, because some areas of the photographs were masked to avoid the projection of interposed elements. The creation of ortophotos enriches the graphic documentation, particularly regarding the current state of conservation of the building, and it is a useful basis to develop detailed drawings.

The restitution of archaeological remains specially complicates the selection of the information of the points cloud and of ortophotos. The drawing criteria were determined by the necessity to reflect in the documents the limits of each sector and the cutting of materials of the walls and adjacent elements. Due to the great irregularity of surfaces and their different states of conservation we proposed a drawing code that allows to identify areas where the joints of the stone are visible with a higher or lower precision. This distinction doesn't reflect any analysis of surfaces. It is exclusively related to some exigences of graphic restitution.

In this context this work faces the unavoidable difficulties of the representation of building remains in a high state of disrepair. We tested a method of graphic restitution from the survey results aiming to add a useful information towards the development of the analysis of the walls. Architectural survey stands as an integrated study of buildings which determines the exigences of the graphic restitution according to the specific goals of the research (Figs. 7 and 8).



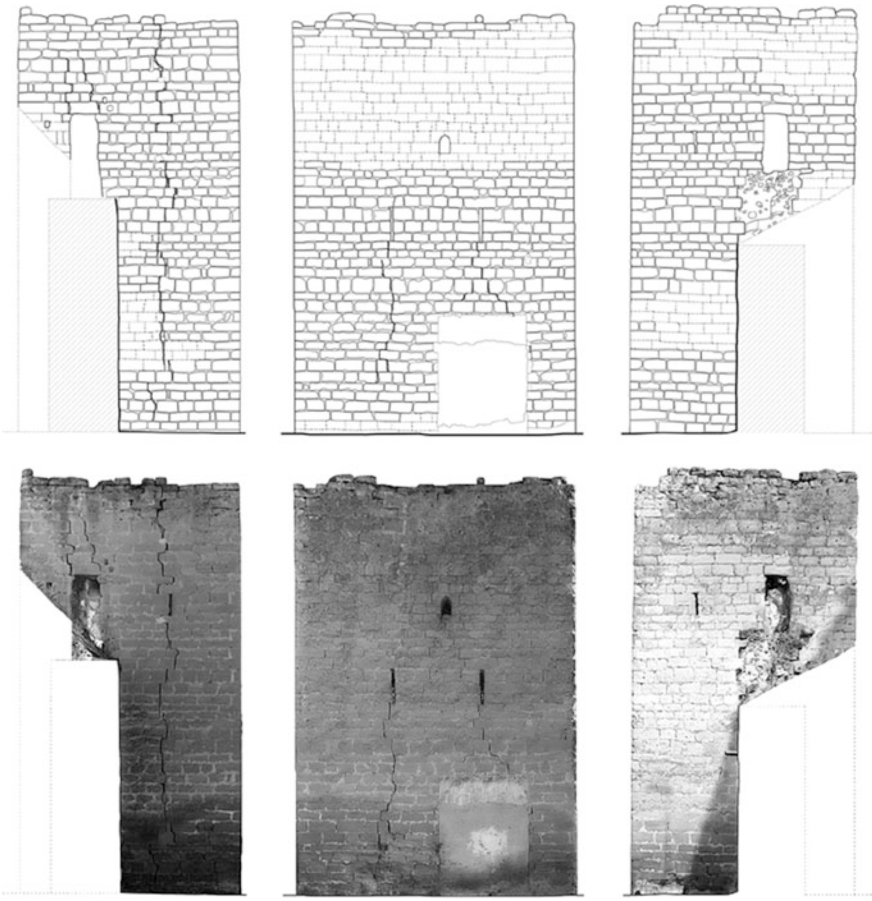
Figs. 7 and 8 Plan, elevation and section of one sector of the walls

3 Conclusions

This work consolidates automated digital photogrammetry as an effective, practical and economic method of survey of architectural and archaeological heritage.

The case study presents obvious difficulties and the restitution of a great number of sectors would provide a long work by using other survey methods. Furthermore the use of three-dimensional laser scan would cause considerable expenses and the necessity of complex software. This conditions would consequently minimize the number of possible operators. The introduction of automated systems for the creation of point clouds and the conservation of chromatic values of the objects highly enriches the quality of the graphic documentation.

Moreover it should be noted that plans, elevations and sections are necessary drawing tools in the study of architecture. Opposite to the direct use of the



Figs. 9 and 10 Elevation and ortophoto of one of the towers three-dimensional models, which usually describes this kind of restitution, the architectural drawing add the possibility to analyse the object by a critical selection of the information. (Figs. 9 and 10).

The application of these documentation and reconstruction methods represents an obvious progress in the study of heritage and offers a large quantity of high qualified information, that may deepen into a further knowledge and conservation of architecture.

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Graphic Sources for the Study and Restoration of the City Hall of Seville

Antonio J. Albardonedo Freire and María Dolores Robador González

Abstract The aim of this study is to outline the use of antique plans and photographs of the 19th century of Seville City Hall, in order to learn about the shape of its decorative motifs before being restored. By doing so, the most advisable and suitable restauration patterns have been selected in the various restoration stages. Up to now, seven restoration projects have been carried out. The two firsts inside the building itself: the 16th century Sala Capitular Baja and the renaissance stairs; additionally, five different projects of both the renaissance and neorenaissance facades.

Keywords Plans · Photographs · Restoration of the Seville city hall

In this paper we aim to launch a study on existing graphic fonts and necessary to resolve issues raised throughout the various stages of the restoration of the building of the Seville City Hall, which began in 2005 and today continues in its seventh phase. In these stages, the first two allowed restoring the Chapter House and the staircase of Renaissance building, and the remaining five stages to restore various sections of the facade was made: the entire front perimeter of the Renaissance and a large part of the neorenaissance extension. It remains to restore the neoclassical facade of the building.

In the archives, the oldest surveying preserved is the XIX century and is applicable to both the portion of the building built in the XVI century, as the projects of neoclassical building extension. These plans, along with photography

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have enabled us to optimize the descriptions from the XVI century detailing different aspects of the building.

Among the graphic representations we can highlight two types: general plans and details. We have compared these graphs sources with historical descriptions by writers. The lack of technical information of these writers have supplied the highest architectural education and careful technical and detailed precision of the authors of the plans. That has allowed us to know better and quality projected. Also, through the comparison between the project and built, we have all reform projects, both made during the course of the work, such as those in later times.

However, more detailed evidence has come through the work of photographers. They collected almost all the construction phases of the facades of the XIX century and the restoration of the various architectural elements and specific blocks. In most of the cases were not represented in the drawings, or modifications of the initial project. Inside the building retain fewer graphic and photographic sources and are of lower quality, but are relevant.

Collect this large set of graphic sources, which continues to grow for being the most photographed building in the city has allowed access signs about details before degradation. The diseases have several reasons: violent attacks, blocks with sandy state, replacing blocks that modify the original shape, etc. Ultimately, photography has allowed to observe the general appearance at all times had the building during the past 150 years, both indoors and on the facades, in the structural elements, ornaments, sculptures, and even reaching the capture detail various commemorative plaques and the modifications undergone reforms and restorations (Figs. 1 and 2).

1 Plans of the XVIII and XIX Centuries Block Convent of San Francisco and City Hall

A nineteenth-century drawings and photographs of the City Hall of Seville, we can add other sources XVIII century. Specifically are three views titled *Máscara de la Real Fábrica de Tabacos en la celebración de la exaltación al trono de Fernando VI y Bárbara de Braganza*, executed in oil by Domingo Martinez in 1747, which appears in the background of the pictures, painted in great detail, the City Hall.[1]

As for surveying the XVIII century, we have the general map of the city sketched by Francisco Manuel Coelho and printed by José Amat in 1771, commissioned by the Assistant Pablo de Olavide; and the backplane of Tomás Lopez de Vargas Machuca, 1788, the latter is dependent on the uprising executed by Coelho

[1]Museo de Bellas Artes de Sevilla, Carro del Aire (Inv. nº CE0553P); Carro de Víctor y del Parnaso (Entrega de los retratos al Ayuntamiento) (Inv. Nº CE0555P); Carro del Parnaso (del homenaje de Apolo y las Tres Nobles Artes a los Monarcas) (Inv. Nº CE0556P).

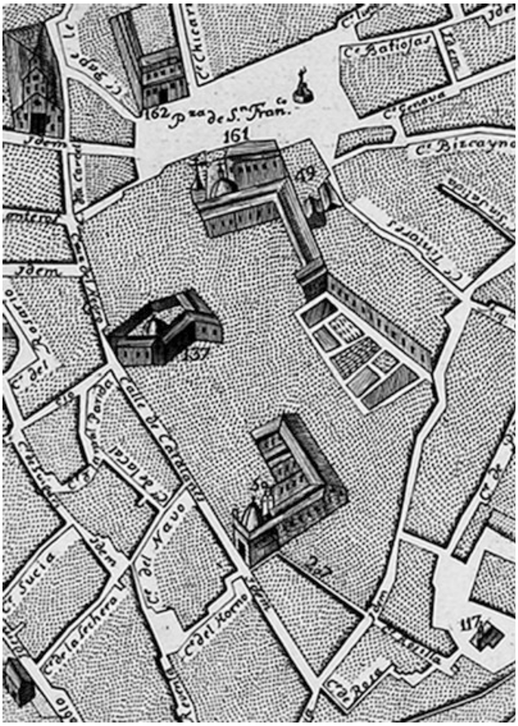


Fig. 1 Francisco Manuel Coelho (lev. y dib.), Joseph Amat (grab.) *Plan of Seville* (1771), awarded by Real Academia de San Fernando, Sevilla. Plans of population [Olavide's plan]: 49, Conv. S. Francisco, 50 Conv. San Buenaventura, 137 Conv. Terceros Franciscanos, 161 Casas Capitulares

in 1771. In the first of 1771 is an imprecise volume of the brickwork, placed on the site of the City Hall of Seville, though interest in the perimeter of the building measures, especially by the accuracy it was sketched this plane (Algarín 2000).

In the first half of the XIX century we have two general plants in the big block that included the Convent of San Francisco in 1821. Both plans are part of a report on the administrative record license denial and the consequential claim of ownership which requested construction permit to build on a site that had already decided to build Plaza Nueva.[2] In one of these planes of 1821 it included a detailed representation of the convent and an interesting floor of the municipal building, where the different rooms of the City Hall which is colored in a blue tone to distinguish it from the rest of the convent of San Francisco will appreciate.

[2]Municipal Archives of Seville (hereinafter A.M.S.) Section IX-4-35.

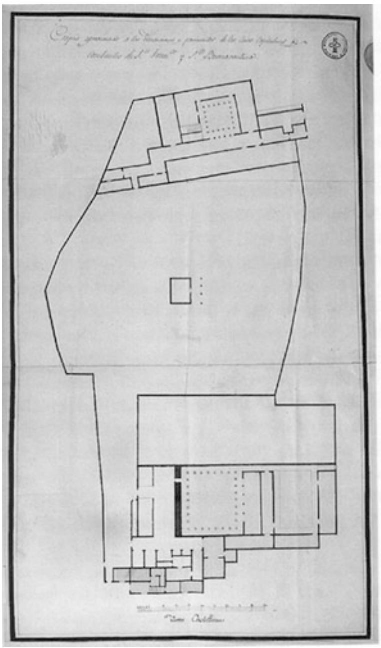


Fig. 2 Anonymous. Plan of the convent of San Francisco of Seville (1821). "Croquis de situación aproximado a las situaciones y partimientos de las Casas Consistoriales y conventos de San Francisco y de San Buenaventura". Municipal Archives of Seville (A.M.S. Section IX-4-35)

2 The Area Occupied

The restoration of the building, first Renaissance building of the old limits were raised. This occupied a small area of the block to be shared for three hundred years the convent of San Francisco. Soon we identify the dividing wall of both Hall and convent buildings on the line the west wall of the Sala Capitular Baja. The preserved buildings are analyzed, drawings and two the most important existing photographs of the demolition of the convent is a calotype by Francisco de Leygonier, ca. 1859, in it has left no referencewhich he captured the demolition of the convent of San Francisco, for the extension of the City Hall of Seville and to open the Plaza Nueva. The creation of this square was implemented with an initial project of the architect Ángel de Ayala, which included the layout of new streets and blocks, and the great expansion of the City Hall of Seville performed according to Balbino Marrón project.

Most plans and photographs of the City Hall come from the second half of the XIX century. They were created for the new extension of the building and for the restoration of Renaissance facade; these amendments in the last three decades of the XIX century, a period that coincides precisely with decades of generalization of photography. Therefore, since 1841 we have plans to expand the building and the

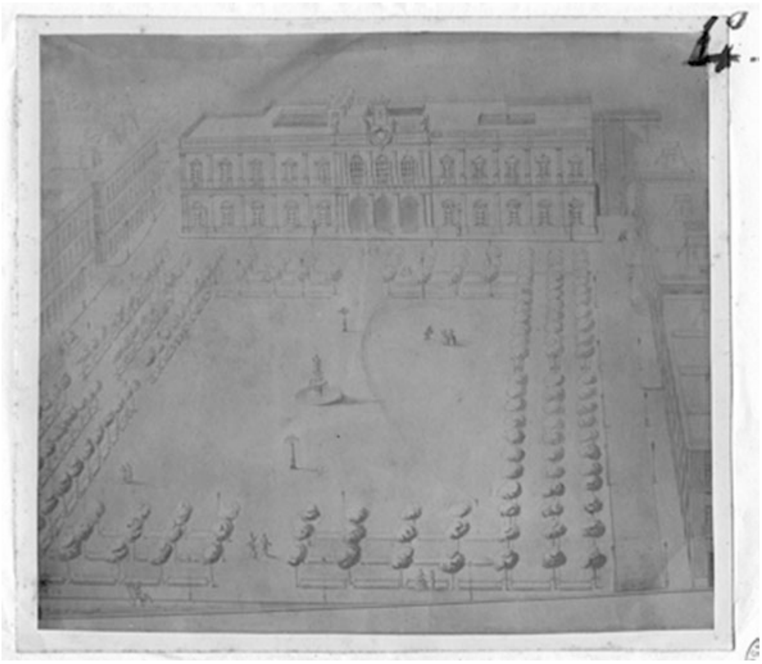


Fig. 3 de Ayala, Ángel (Arch.). *Proyecto de Plaza Nueva*. Photographic reproduction of the plan: calotype by Francisco de Leygonier, ca. 1859 (AMS Reg. No SAHP_03435)

first daguerreotypes and calotypes. In particular, some are simple reproduction of plans, such as that of F. Leygonier made in 1841 from a perspective of the Plaza Nueva, today preserved.[3] The photograph of this plan includes the City Hall as part of the square project by the architect Ángel de Ayala. Perspective drawing was reproduced photographically appears many times in the years 1851–1861 (Yáñez Polo 2002, 37). We also have a number of photographs taken with the technique of wet collodion albumin from 1850 onwards, which preferentially collect XVI century building. In these photographs they were also registered multiple phases of the restoration carried out in that magnificent Plateresque facade from 1875 (Fig. 3).

Among all the issues that we have been able to enrich the knowledge of new graphic fonts, it highlights one that has been immensely rewarding; we mean to record how they were advancing the work of neorenaissance carving of reliefs from 1890 to 1973, decorating the monumental facade of the building and removal of the balcony of proclamations (1860), the installation of the upper balustrade (1876),[4] or

[3]A.M.S. Plan SAHP 03435.

[4]Executed by Jose Frapolli and request payment of the amount of the work on 1 April 1876. A.M. S. Secretary C. City Hall, No. 1–8. (Morales 1981).

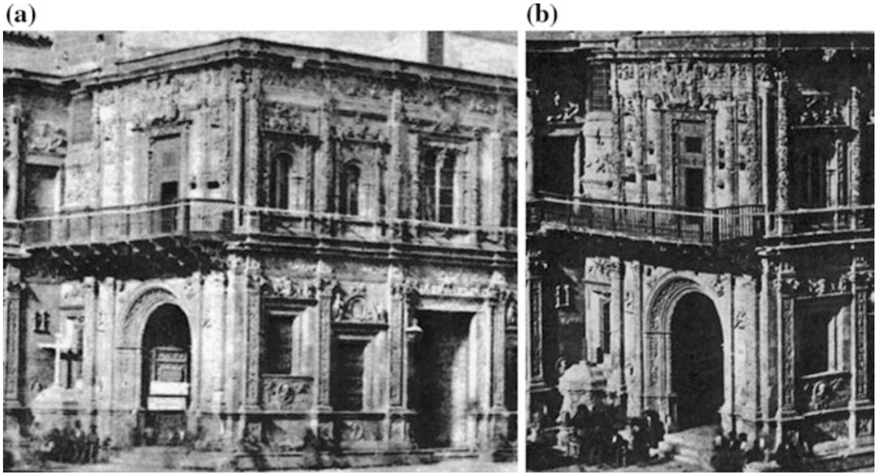


Fig. 4 **a** Launay, Alphonse. 1854. Collection of the Duque de Segorbe. **b** Vigier, Viscount Joseph. 1851. Collection of the Duque de Segorbe. Detail from the balcony of proclamations

the placement of the nineteenth-century statues of Hercules and Julius Caesar on either side of the Arquillo.

Also important was the knowledge of the conversion of ancient doors in windows, as well occurred in the late balcony proclamations; we refer to the doorway leading from the balcony with the Archivo and this with the living Antecabildo Alto, besides the door of the Sala de Fieles Ejecutores in the part of the Arquillo.

3 Neoclassical Enlargement Projects by Balbino Marrón. The Monumental Facade of the Arquillo Section, a Draft José Demetrio de Los Rios

In 2005, for the restoration work we have obtained interesting results in the investigation of the Archivo Municipal de Sevilla, where we find the planes of eleven architectural projects of building extension signed by Balbino Marron (1852–1860) and two planes of the monumental facades signed by José Demetrio de los Rios in 1875 (Figs. 4, 5 and 6).[5]

In the same City Archives we have studied the records of official works, as well as finding interesting particular about the restoration of the monumental facades, concerning the last three decades of the XIX century. Furthermore, we have studied the Fund Gestoso of Colombina Institution. Jose Gestoso y Perez (Sevilla, 1876–1917) was academic, the City archivist and historian, said throughout his life as a strong

[5]M.S. Archives, Alphabetical Section, 189–196.

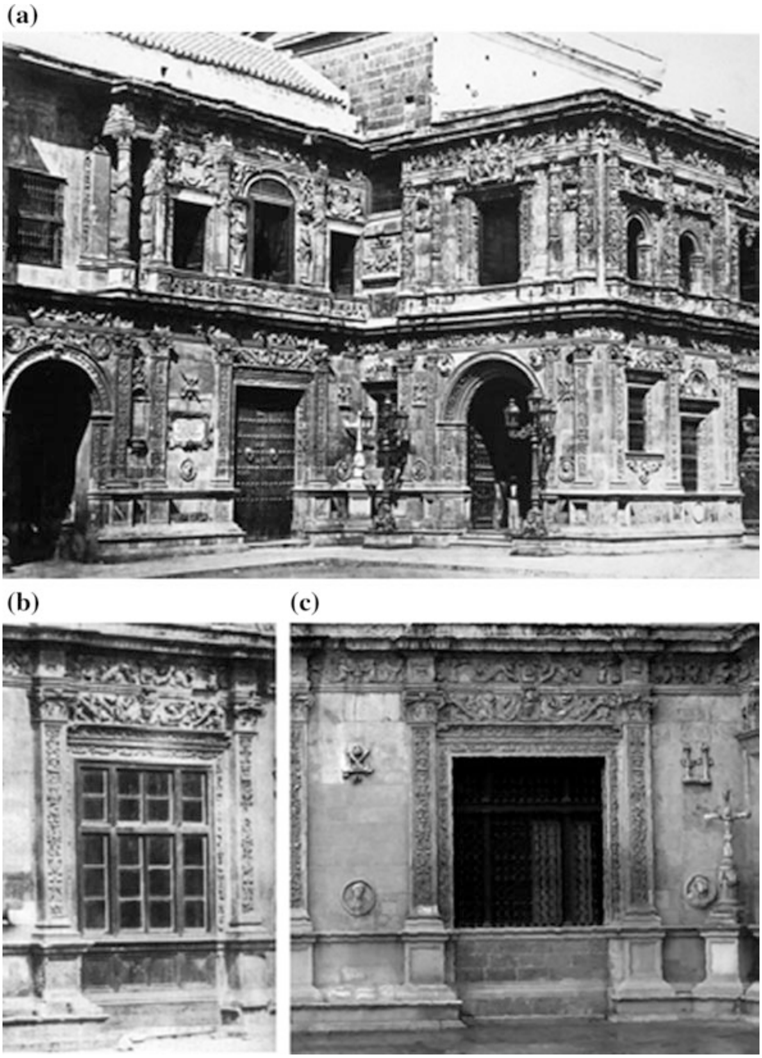
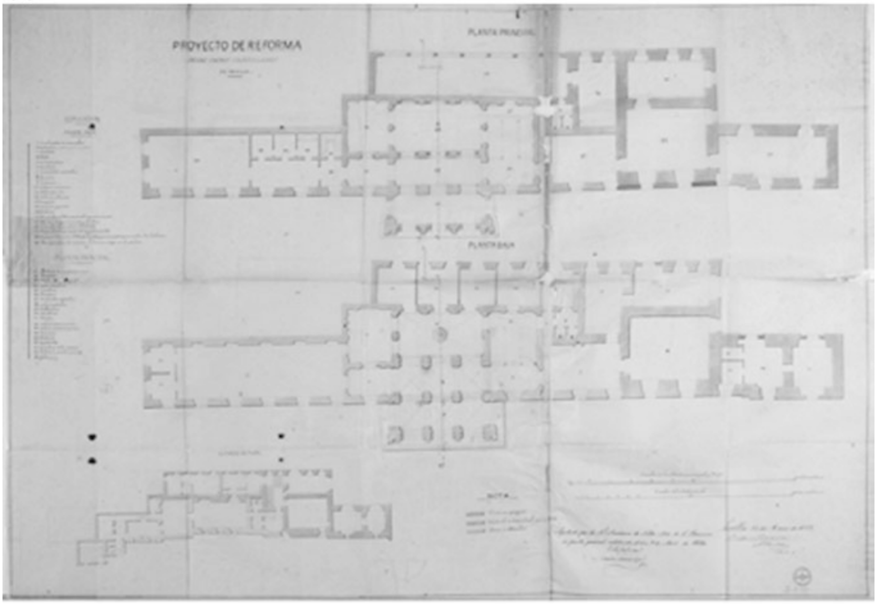


Fig. 5 **a** Charles Clifford. *Álbum de Andalucía y Murcia. Viaje de S.M. la reina Isabel II de Borbón y la familia Real en 1862*. In the picture, on the first floor, two old gates to the old balcony were already converted into windows. Still remained the door lintel of the Sala de Fieles Ejecutores. **b** Lucien Levy 1888. Part of the Arquillo of the City Hall of Seville. Details of the conversion of the opening from the Sala de Fieles Ejecutores. Close carpentry. **c** The current status of the door turned into a window. Quarry *bottom* closure. Author Photography

advocate for the protection of monuments, becoming President of the Provincial Commission of Monuments. He was the director of several works of restoration of the City Hall and took active part in the criteria to be followed in the works. His personnel files comes some interesting graphic materials, mainly drawings sketches

(a)



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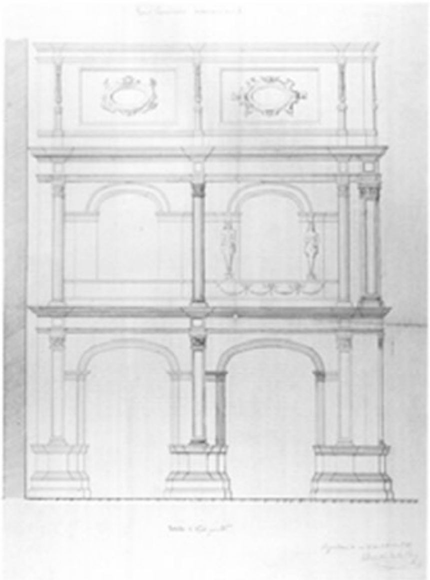


Fig. 6 **a** Balbino Marrón. Enlargement project of the City Hall of Seville. March 13, 1853 (A.M.S. Reg. No. SAHP_03951). **b** José Demetrio de los Rios. *Proyecto fachadas monumentales para las casas consistoriales*, 1875 (A.M.S. Sec. Alphabetical 189–196)

of landscapes and complementary levels, such as those concerning protection bars the facade.

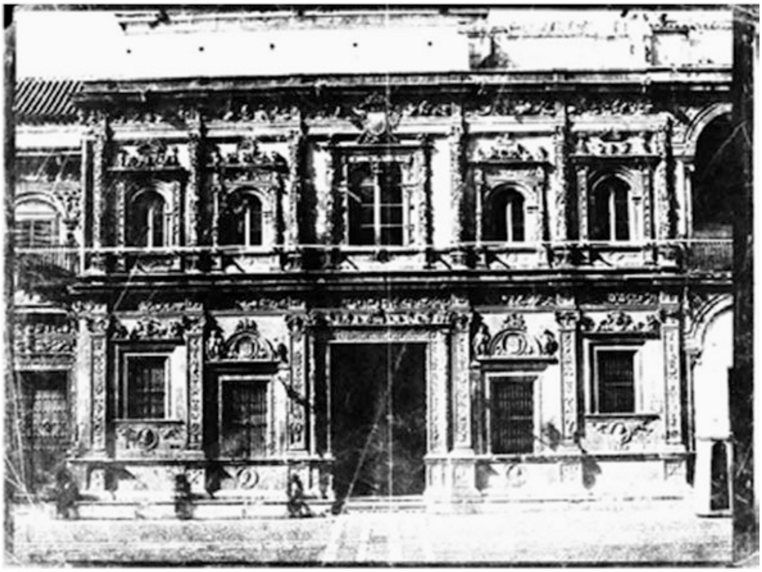
As mentioned above, the photographs of the XIX and XX centuries, preserved in the national and european photographic libraries in which we have been able to obtain important information for understanding the building and sustained reforms, have been of great value in restoration of the building. Among the highlights photographic libraries, by the amount of information, the Municipal Photographic Library of Seville and the library of the Institute of Historical Heritage of Madrid. The collection of photographs from the National Library of Spain and the Photography Collection of the University of Navarra have been very helpful. Also in the Fund of Mas Institute of Hispanic, Amatller Barcelona Foundation, we were able to find details that had not been seen in other photographs, in addition to the architectural details from the Fund of the Laboratory Photographic of Library Art of University of Seville. These highlighted the Institut National d'Historia of Art, Paris (INHA) where we found a large number of photographs, mainly of French photographers, and digitized with an extraordinary quality, capable of recording to the smallest details of the initial state of conservation, as well as the replacement of damaged stones, or new work carving stone. Finally, in the photo second hand market we are constantly finding unpublished photographs of the early days of photography from 1850 to 1880, we have not seen before, and they have an undeniable documentary value. These findings to optimize plans and historical writings, besides getting more and more information about the original appearance of the facades, sculptures and modifications suffered in the renovation and restoration.

Following the adaptation of the building Renaissance to new needs during the second half of the XIX century, there was a great neoclassical enlargement. Graphic sources have been transcendent to study this gallery demolished in the Plaza de San Francisco, built by Hernán Ruiz II. During the restoration on the east facade of the building some problems of cracks and height difference in the structure floors, in the analysis of the graphic sources have confirmed the coincidence with the exact line between the work of the XVI century Renaissance and detected the expansion of the XIX century. At the same time we have studied the communication openings that had existed until the XIX century, from the Renaissance staircase with gallery Hernán Ruiz II. Today these openings are loculated and replaced by alternative ways of communication (Figs. 7, 8 and 9).

Also the graphic sources have allowed to study the opening of a new door opened in the XX century, giving access from outside the building through the Arquillo into the Sala de Fieles Ejecutores. This new door is prior to 1862, year in which collection appears in a photograph of Charles Clifford.[6] Or in the XX century, the new communication opened between this Sala de Fieles Ejecutores and the Sala Capitular Baja. It has also been shown the opening of two windows in the XX century in the west wall of the Sala Capitular Baja.

[6]Clifford [1862] 2007, Cat. No. 28.

(a)



(b)

Fig. 7 **a** Anonymous. *Séville, facade de l'hôtel de ville* (Negativo). Bibliothèque Nationale de France, département Estampes et photographie, BNF Reserve EI-37-BOITE FOL B, n° 11. *Right edge*, limit the current Renaissance building, and starting from the old gallery of Hernán Ruiz II in the City Hall. **b** LAURENT, Jean (fot.), 1865. Historical Heritage Photo Library 03354 File No. VN-Ruiz Vernacci. *Right edge*, scaffolding and expansion of City Hall

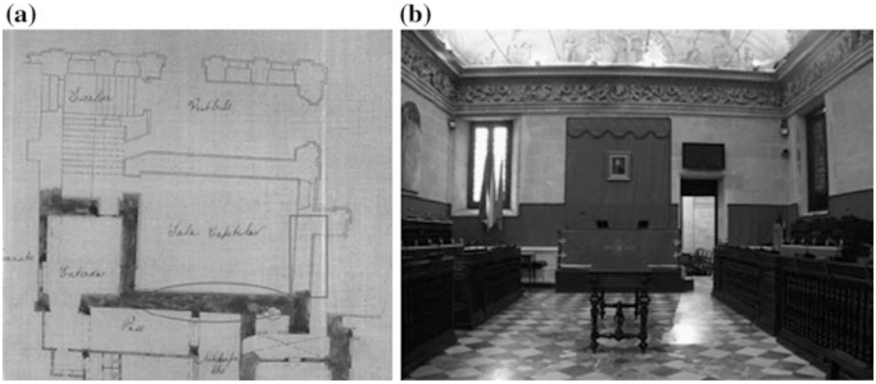


Fig. 8 **a** Anonymous. 1864 Relocation project secretary. Detail Sala Capitular Baja (A.M.S. Alphabetical Section 191, Exp. 19). South and west walls of the City Hall where in 1929 a door and two windows were opened **b** Sala Capitular Baja. Author photography. 2005

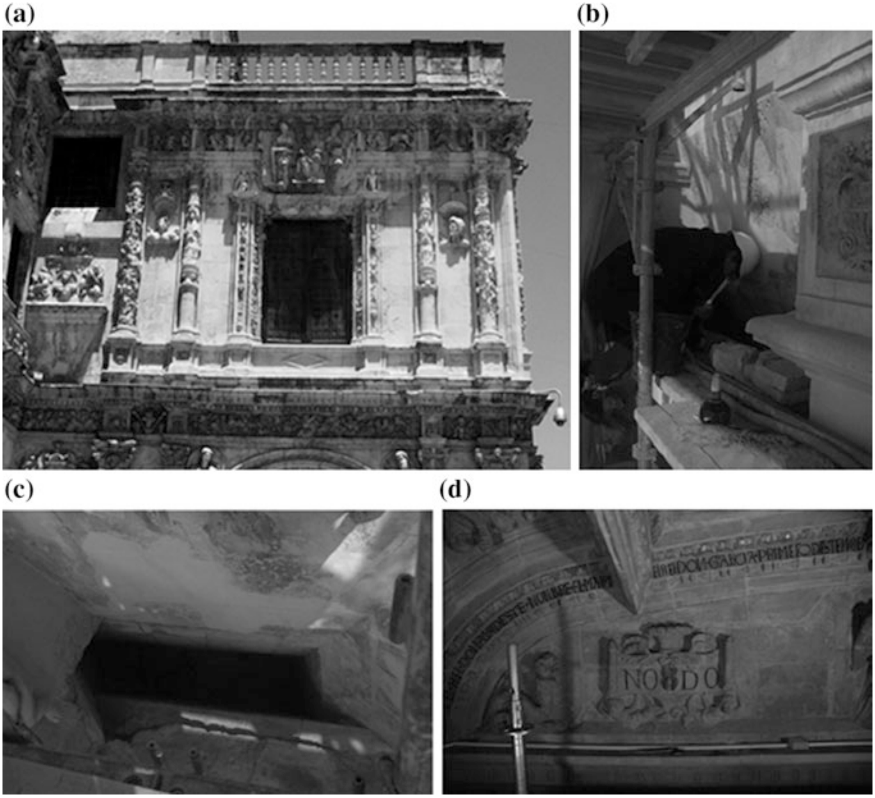


Fig. 9 **a** Main facade of the XVI century, on the first floor manifested framed pyramidal skylight, now blinded, southbound. **b** Noting inside the blinded skylight. **c** Interior open during construction skylight. **d** Interior of the Sala Capitular Baja, south wall, stones and decorated with gusset NO8DO text, blinding the skylight in the XVI century. Author Photographies

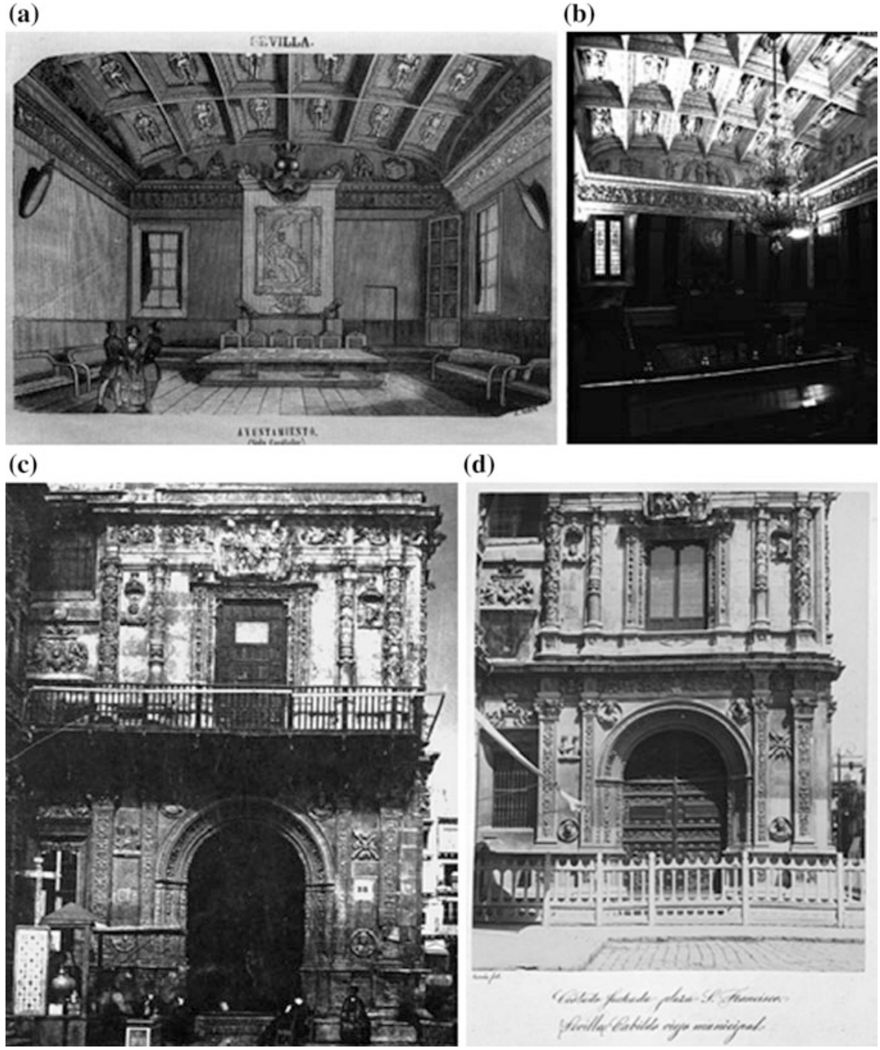


Fig. 10 **a** Álvarez Miranda, Vicente (Álvarez 1849, 64). **b** Palau, Antonio (fot.), Sala Capitular Baja. (1966) Photographic Library of Laboratory of Art. University of Seville. **c** Vigier, Viscount Joseph (fot.), 1851. **d** Anonymous, Ca. 1907-1910. Collect the third gate protection work carving the facade and leaves wooden door, by sculptor Bellver restored under the leadership of José Gestoso (1910)

Graphic sources have been crucial to locate the old balcony of proclamations was on the south facade of the XVI century, and the transformation of two entrances to it, windows. This balcony was located on the main gateway into the building of the City Hall of the XVI century. Also during the restoration work we have been able to verify the closure, perhaps in the same XVI century, a skylight from the balcony of proclamations let penetrate the sunlight to the Sala Capitular Baja, unless the material remains, it has left no reference documentary film.

Photographs, prints and oil paintings have allowed to study the ancient votive cross, and replacement in the last quarter of the XIX century by a new cross at the angle of the old main door of the City Hall.

Graphic sources have made it possible to study the replacement of degraded blocks. They were damaged especially those carrying sculptural decoration and mouldings, which were the subject of extensive replacement by others during the restorations of the XIX century, in the bottom of Renaissance facade, as in other blocks scattered throughout it. Finally, the graphics sources have been used to study the concealment with jabelga in two ancient legends: one on the relief of the large shield of the city and other major existing perimeter legend on the cornice of the Sala Capitular Baja. This one last was replaced by a new calligraphy of the XIX century, with the same text. Overall, there have been numerous replacements degraded blocks for new reliefs on walls and doors, which were subject to renewal with neo-Renaissance works of late XIX and beginnings of XX century (Fig. 10).

Graphic sources have also allowed the knowledge of the development of pathologies in architecture, the reliefs and polychrome building. Similarly improved facilities such as indoor electrification of the Chapter House Baja, which was the first held in a building of Seville, for the royal visit in the IV Centenary of the Discovery of America, 1892.

Extremely useful was the knowledge of the evolution of interior decoration, or building protection against vandalism with up to four different bars of wood and iron.

Definitively, we must acknowledge the extraordinary contribution of the plans, drawings and photographs that have allowed us to take rigorous and extensive knowledge of the various stages of its existence, the restoration of the building.

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The Graphic Expression of Urban Planning in the Twentieth Century

Laura Rives Navarro

Abstract In the research of the urban development of Spanish cities in the XX century we find the influence of European trends, but with own profiles for each city. In article aims to analyze the different techniques of graphic expression used in urban planning at each stage, the relationship of this with the prevailing trends at all times: Expansion plans, zoning plans, plans of development policy, reform plans, municipal plans new generation and systematization of GIS for urban planning.

1 The Graphic Expression of Urban Planning in the Twentieth Century

In the investigation of the urban development of the Spanish cities in the XX century we find the influence of European trends, but with own profiles for each city. Article aims to analyze the different techniques of graphic expression used in urban planning at each stage, the relationship of this with the prevailing trends at all times. As well as the latest trends towards systematization and standardization.

In the twentieth century, the city experienced unprecedented growth. It is therefore decided to carry out a historical journey from the planes of the century found widening projects to standardization proposals planning tools GIS some cities and regions are using today.

Urban planning instruments that have enabled the development of our cities are multiple depending on the scale of the field to order and different urban legislation that have been approving. While this legislation defines the content that must have each of the instruments as well as graphics and text documents to be processed, with the exception of plans for expansion until the early twenty-first century they

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have not begun creating instructions planning for the standardization of planning instruments and their criteria of graphic expression.

This implies that if we take the Metropolitan Area of Pamplona, whose urban continuum is composed of eighteen municipalities that comprises, has eighteen different general plans, drafted with different laws and also each of them has their planning instruments which amplify or modify the proposed management by the general planning (more than four only in Pamplona), made by different authors and their own techniques of graphic expression.

Planning legislation originated in the second half of the nineteenth century as a reaction to the hygienic and social problems of urban marginalization of the industrial city, which determined the development of modern urbanism.

In Spain, the first major urban renewal came with the ecclesiastical confiscation (1936), which affected the existing monasteries in the cities, which were adapted to give a destination in accordance with urban needs and the establishment of public services: barracks, hospitals, council, schools, colleges, markets, theaters, prisons. installation utility. The operations of urban growth plans prepared by the geometric form of the stocks sent the Royal Order of 25de July 1846. In particular, asked "geometric planes of stocks at 1: 1250 and" be framed with conventional lines the alterations are to be made for future alignment of each street, square,… Still in force, it emerged the R.O. 1848 limiting the application to provincial capitals and towns with more than 8000 inhabitants, and R.O. 1849 established conditions for "military spaces" as Pamplona, reserving the Corps to lift the controversial areas of the fortifications, and the interior space adjacent to the walled enclosure. The R.O. 1859 was an instruction which requested have plans to launch the works aimed at the improvement of the cities, smooth condition of the individual. Instruction contained a model plane plans to lift alignments populations and precise articulated in which "the plans are clear, and facing the street names is requested; delineated specific mode to distinguish graphically represented; specifies the scale for alignments (1:300) and to the general plan (1:2000); and requests the layout of the new alignments provided, flush with a longitudinal profile." (Ordeig 1992).

However, in the case of Pamplona Instruction it not met since instead of establishing a generic plan, partial rushing performances, and overall alignment plane was late. Plane Miguel Co. de1866 merely draw the current state of the city but citadel and walls, so the plane full lineups of the city was not obtained until 1882. This plan was commissioned by the City Dionisio Casañal and Zapatero, surveyors corps officer, who also designed the plans for other cities: Zaragoza (1880), Cordoba (1884), Vitoria (1888), Huesca (1891) and other 16 municipalities in Navarra. The comparison between the plane of Pamplona Casañal 1882 and its revision in 1904 allow us to appreciate the latter construction of the first expansion of the city and demolished its walls.

But it was not only difficult to achieve this unit plan of the city, urban development works carried out since 1836 assumed specific improvements (regular street layout, new facilities, improved sanitation…) but lacked the unified vision, existing concrete problems solved, I am widening the I even raised for the whole city and long term.

In Spain, the great urban operation of liberalism in almost every city consisted of the demolition of the walls, which had failed to fulfill its defensive action and allowed the expansion of Spanish cities by the extensions. In some cities like Barcelona, the Example of Ildefonso Cerda, with a unified vision and a social approach, he tried to solve housing problems, circulation and quality of life. After the experiences of other extensions in Madrid, Bilbao and San Sebastian, was the need to regulate urban development operations that promoted the new building, and the Law of Extension of Populations, 1864. Subsequently approved regulations 1867 was approved in the that the contents of the technical planning of the Act detailing, specifying how to run the extension plan and its contents: memory, flat (general plan and comprehensive study of grade) and economic plan for viability. A level of management fees and charges of the landowners and the government-securities voluntary transfer of vials and execution areas indicated (Fig. 1).

In the case of Pamplona, different projects Example raised between 1908 and 1915, each proposed extension of the city with reticular tissues of different dimensions, different orientations and different location, however, have in common the representation of graphic elements: in black ink on urban and agricultural parcel, the city walls, access roads and the layout of the existing railroad in the lipstick and superimposed on the above ink new developments proposed by the widening, both new build plots were represented, like gardens, and blue the route of Arga river. In addition, it is filling parcel using a grated or solid frame both the existing and the current allowed to obtain a map of solids and voids which clearly public spaces of the city were distinguished (Garcia, Ros and Marti 2012, 204–205).

In Spain, the rules of the extensions was not able to solve the problem of shortage of housing for economically disadvantaged classes, so cheap houses Act was passed in 1911, which gave subsidies and tax incentives for low-cost housing, allowing the construction of some working-class neighborhoods. The union of this new law with European trends in urban garden city led a'ciudades satellites' cheap housing, neighborhoods developed away from the villages whose lands were cheap and allow the decongestion of the center. For Pamplona, the proposal materialized in Colonia Argaray within the limits of II Ensanche, based on the Cheap Houses Act 1921, but she did not refer to the graph should have made these projects (Fig. 2).

But population growth in recent years and the industrial development continued increasing demand for housing, the processing operations of the old quarters and building plans expansion produced homes, which by its high costs, were occupied mainly by residents leaving as the only alternative to the new social strata who agreed to the city and did not have enough purchasing power to stay in the Example recourse to disordered growth in the periphery.

He trained well, what Ramón López de Lucio called the 'other city' peripheral and marginal plots, under inconsistent planning, the result of the emergency response, almost no alignments or licenses, composing a mosaic disjointed and incoherent parts dissimilar, low quality construction and urbanization. These specific and fragmented developments multiplied and consolidated peculiar urban fabric, multiform and fragmented grids extensions precarious low-rise buildings, which formed the peripheries. (Lucio Lopez 1993). This 'other city' unplanned, at

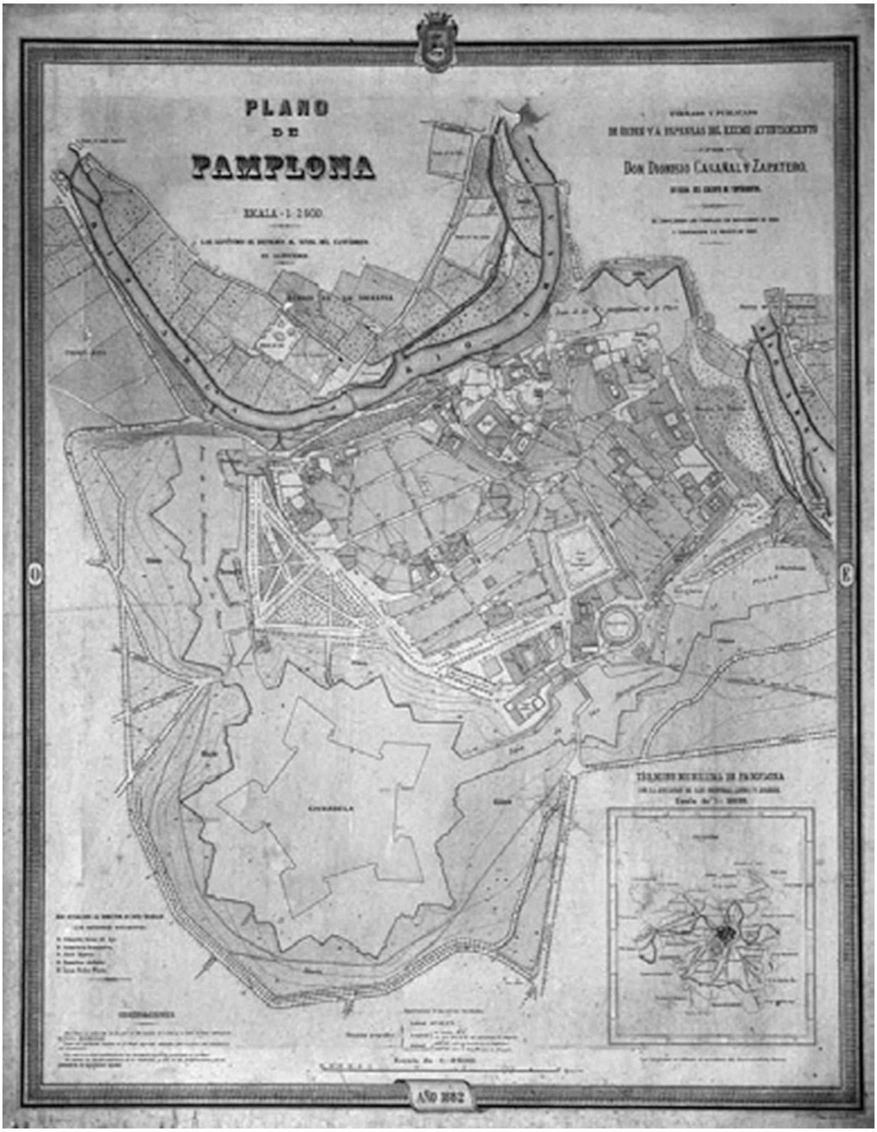

Fig. 1 Casañal plane Pamplona, 1904, A.M.P

best find a map of the current parcel outlined in black and the proposed new streets adapted to existing agricultural roads in red, but graphic expression where new housing will be built.

During the forties, the situation of planning in medium-sized cities continued to perform for municipal agreements with the National Office of Planning, and by so-called extension or General Plans Construction Plans, which were somehow

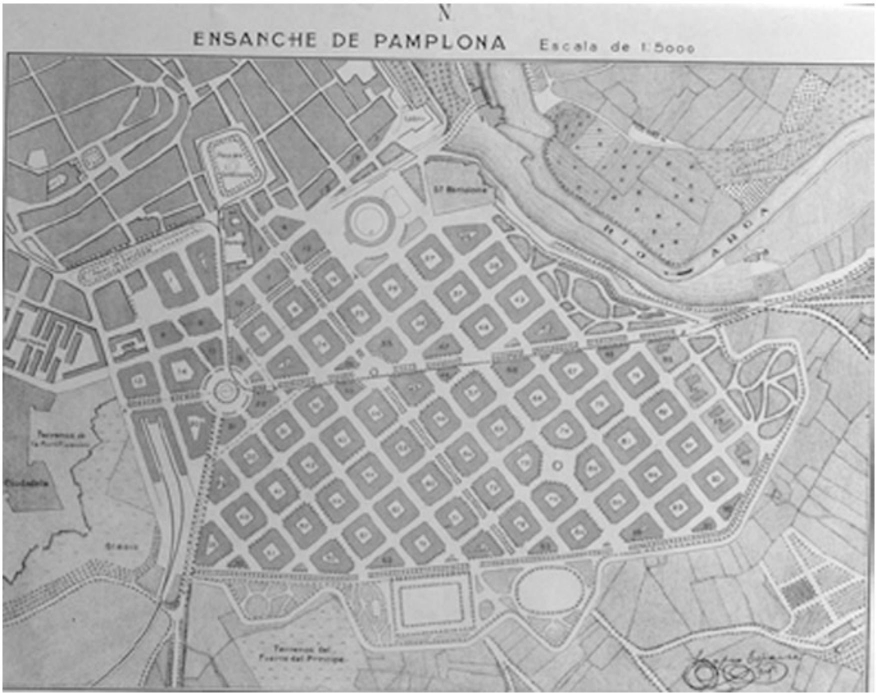

Fig. 2 Plane II Extension of Pamplona prepared by Serapio Esparza, 1915, A.M.P

nineteenth Ensanche plans that They concretaban primarily constructive alignments. However, the occurrence of sporadic growth, lack of coordination of plans of different areas subject to different ordinances and statewide forthcoming new Land Law of 1956 that would mandate that all cities had their General Plan provoked local councils in some cities entrusted its wording to the National Headquarters of Urban Development Ministry of the Interior in Madrid.

These new plans served to introduce a new technique for the preparation of plans: zoning. This new technique involved the incorporation of a 'zoning plan' covering the whole city, and in which different areas were different, giving each area a plot that identified with the functions and building types that would be permitted to build in it, and they were described in ordinances Plan. The legend of the plane indicated the significance of the frames. Gray frame of the old town, in black and white equipment the main roads that structure the proposal and delimiting frames. Frames stripes, squares or points, were of different density and type of line, but always in grayscale, to facilitate future playback. This year, the similarity in the graphic expression of the plans was we standardized, but could be justified on the authors of the Plan. As the drafting by Pedro Bidagor the General Plan of Madrid and Pamplona, where zoning technique was applied, and then be picked up at the Land Act 1956 (Fig. 3).

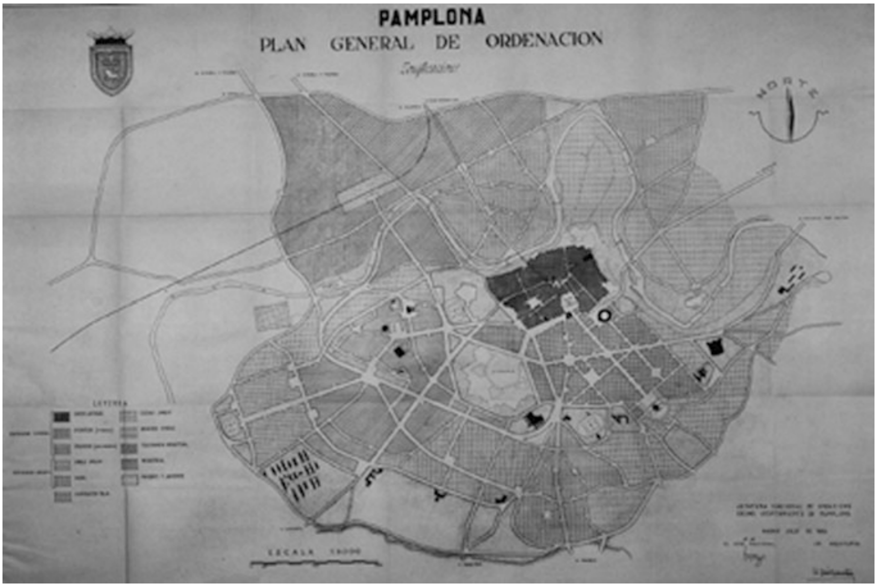

Fig. 3 Plano zoning General Plan of Pamplona

This simplification of zoning was a clear, easily practicable and appropriate instrument to control the elements of the city for which staff and managers had the task of making decisions. The location of industrial activities, provision of infrastructure, the cost resulting from the land, etc., became manageable elements. (Mancuso 1980). Zoning technique is still used today, although at present it should be named 'overall plan uses' or 'qualification level', and the frames are colored.

After the General Plan defined the distribution of uses and densities of future developments in large areas, it was necessary to specify in each area defining the urban, his building types, their relationship with open spaces, the location of the equipment, and therefore, the most appropriate management tool was the Partial Plan and developed areas were called polygons.

The flexibility of these master plans would reflect the principles of the principles of the Modern Movement in the Spanish urbanism of the sixties and seventies, albeit with some delay. Apples against nineteenth widening, the first ordinations showed isolated, open, the arrangement more influenced by rational criteria block sunlight, avoiding alignments and resulted in an undifferentiated space and the perimeter road. The absolute leadership of the edificatoria architecture was shown in the graphic expression of floor plans and prospects, in both the buildings with their cast shadows, remarked on the composition of its volumes (Fig. 4).

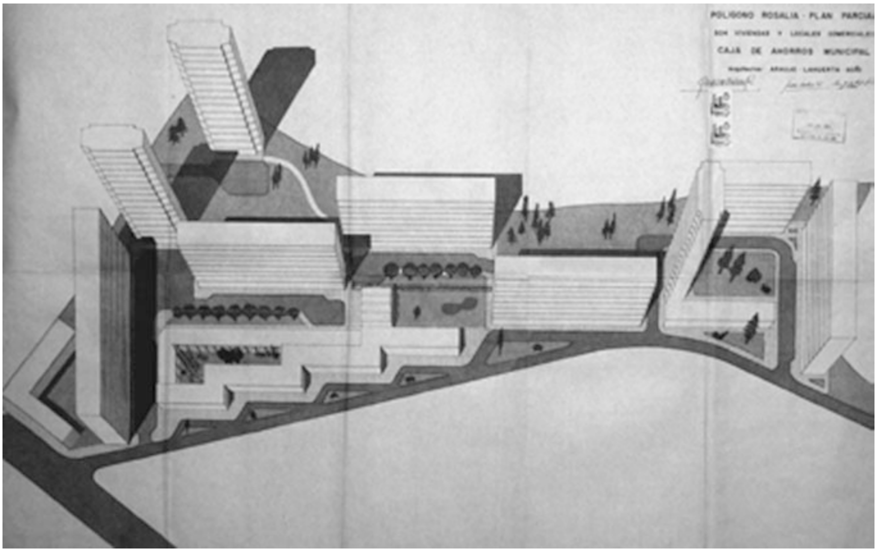

Fig. 4 Partial Perspective Plan project for the polygon Rosalia, Araujo-Lahuerta, 1964, AMP

In the seventies, we find some floor plans and color, in which about edificatorios volumes begin to highlight the gaps. The same plans outlined in black, with shaded gray road, buildings in white and dark gray shadows cast, were colored and different equipment and paved and landscaped open spaces and woodland in green. Woodland alignment or intentional disorder marked the character of open spaces (Fig. 5).

Many of the proposals of partial plans were also presented by models in which urban development is shown as overlapping elements of urban design in several layers: road, open space and construction, mainly emphasizing the composition made with edificatorias pieces (blocks, towers, support buildings) to set spaces. The buildings will be grouped by communities and find plans and perspectives in which the architectural project detailing precisely. This emerging interest in public space is also displayed in the study section, with different levels of a building and its relationship with the public space.

The structural relationship between the various urban elements come with late influence of Team X, which complejizaba program incorporating the Athens Charter social, customs, and technological possibilities. That complexity was formally manifested in the grouping of several volumes forming complex sections, grouping the residential elements, facilities and open spaces depending on the different activities and the various levels of service areas, necessary and sufficient for each institution. To apply this theory it was necessary that the scope was extended and the need for large residential development, as it was in Pamplona South Plan, drafted by UIASA. In the plane and on the model of the South Plan buildings and roads existing city and future city, where the road makes the backbone of the development and connection with the present city appear. The new structure does not arise from the

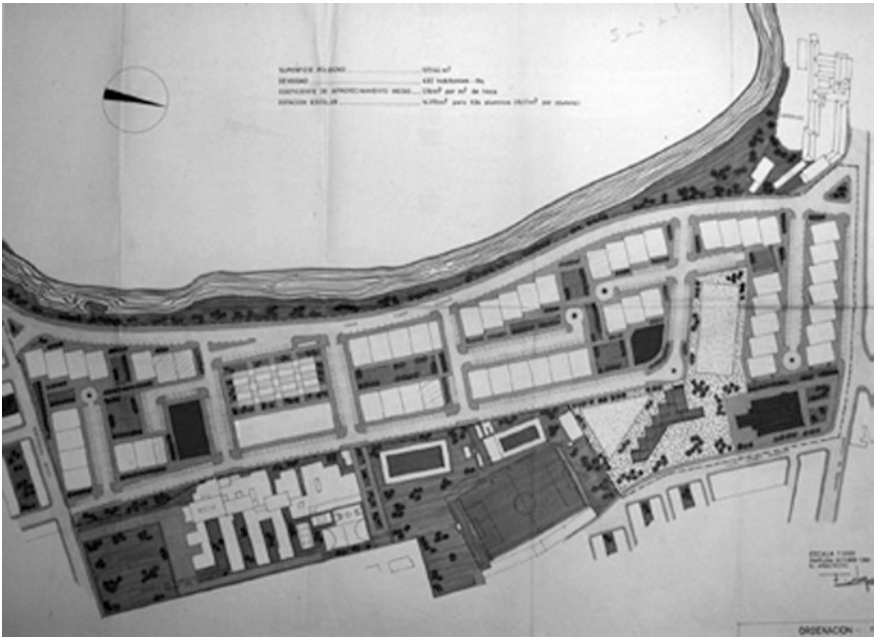

Fig. 5 Spatial Plan Germans polygon, Chantrea –Solution B–, Fernando Nagore, October 1968

mere addiction, but a full study of the city. The design was based on a similar Modern serialization, but his geometry was not so simple and schematic, but could produce the idea of partial identities in different communities, and showed their adaptability to the topography. Even at the most basic level, the proposal showed a complex and varied geometry. On the right, the legend explains plane encoding each of the building types of the new plan, and their heights: squares and rectangles filled with different patterns and in black and white, which when combined into units did raise interesting plastic compositions. The commitment to the geometric shapes of the plot shows the plastic and artistic culture.

In the eighties, after the first oil crisis began to emerge voices for an urbanism of austerity and the general plan drawn up in this period reflect this trend: interest in the recovery of historic centers, complete revitalization of neighborhoods, drawing up special plans and recovery of assets. But these plans were compositionally little expressive, strong normative. Your graphic documentation of zoning and management plans in black and white, complemented the normative texts of the Plan, which conformed to the new regulations of Planning and Management, of 1978.

However, the protagonists of this time will be the Special Internal Reform Plans of the old quarters and studies of pilot blocks. The latter arose from that in 1980 the Council of Europe launched a campaign for the 'Renaissance City' in Spain was completed in 31 studies to rehabilitate degraded historical centers or at risk of degradation. It was not a 'sum of rehabilitation' but a unitary urban project that would allow the recovery of the interiors open space a few blocks of ancient helmets, while their homes were rehabilitated and new ones were integrated. The graphical representation of these projects was based on a detailed drawing of the entire plant, with details of the distributions of all types making up the block, both ground floors, as high and covers. But also they included some isometric perspectives of these pilot blocks, clearly expressing the volume of the set, Gothic batch composition holes in the walls, and pitched roofs that characterize the old quarters (Fig. 6).

In recent years, a large number of medium-sized cities decided to prepare for the recovery of historic centers via Special Plans. Criteria and methodologies of these plans were very different. Its wording required a methodology in the analysis, knowledge and appreciation of different existing elements in the area was vital to the approach of the proposal, much more restrained than in the proposed 'clean sweep' of earlier times. In cities that mostly retained their historical morphology, and which predominated old buildings added in essentially homogeneous tissues, was more frequent use of individualized and based on the timely completion of buildings with a definition of the very thorough action plans. For example, the Special Plans of the historic center of Pamplona, Vitoria, Segovia and Palma de Mallorca… in which planes can differentiate between the levels of information, in which a detailed study of uses and types was made, and plans management or proposal, reflecting the new detailed uses, heights of each of the plots, protected buildings, those who had a

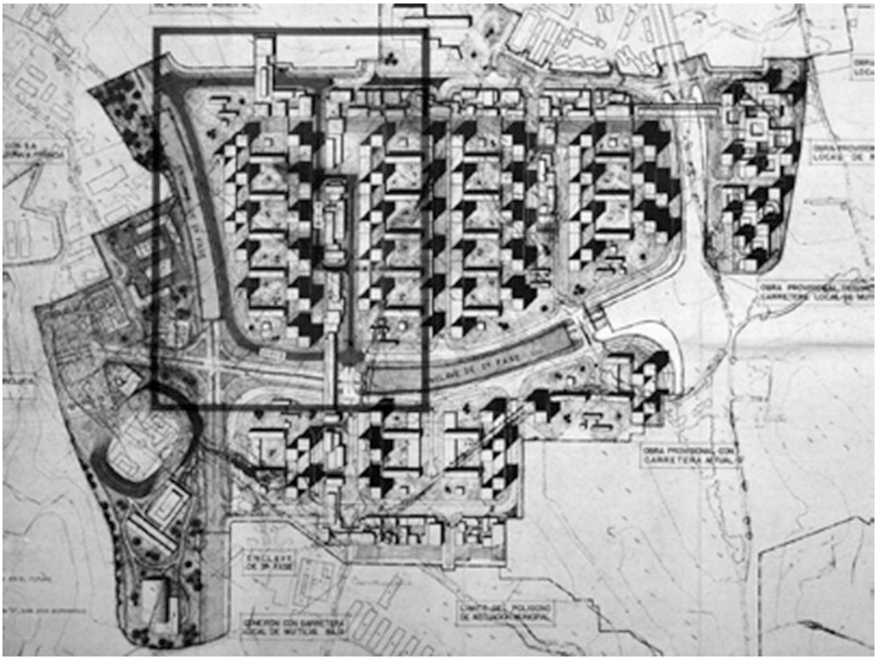

Fig. 6 Plano management, flat volumes and models South Plan, 1968

singular value and may be reused as equipment, and free indoor spaces that could be recovered as endowments. All plans covering the whole of the old town and were represented by a drawing of minute detail, especially in public places, always on the same graph scale and grayscale to enable reproduction (Fig. 7).

In parallel to these Pepris they were made some plans for new developments. These plans were characterized by more geometrized urban plots, hierarchical urban spaces and the minimum definition of edification parts. Regulatory levels continued to be submitted in black and white, but drawn by computer programs such as Microstation, while the level of organization, it was colored on the level of use, facilitating the understanding of the proposal to differentiate more clearly by color and intensity of the layout, the built environment of free, topography, and the area of action concerning what consolidated. We also find complete isometric perspective developments that allow us to understand from an aerial view a proposed residential typologies and very traditional clearances represented very realistic and vivid colors (Fig. 8).

For Pamplona, the development of open spaces that PEPRI was reflected in the proposed pedestrianization of the historic quarter of 1993. Its proposals were expressed with the technique of collage, in which about color photography of each of the streets with people walking, overlapped with an acetate paving and street

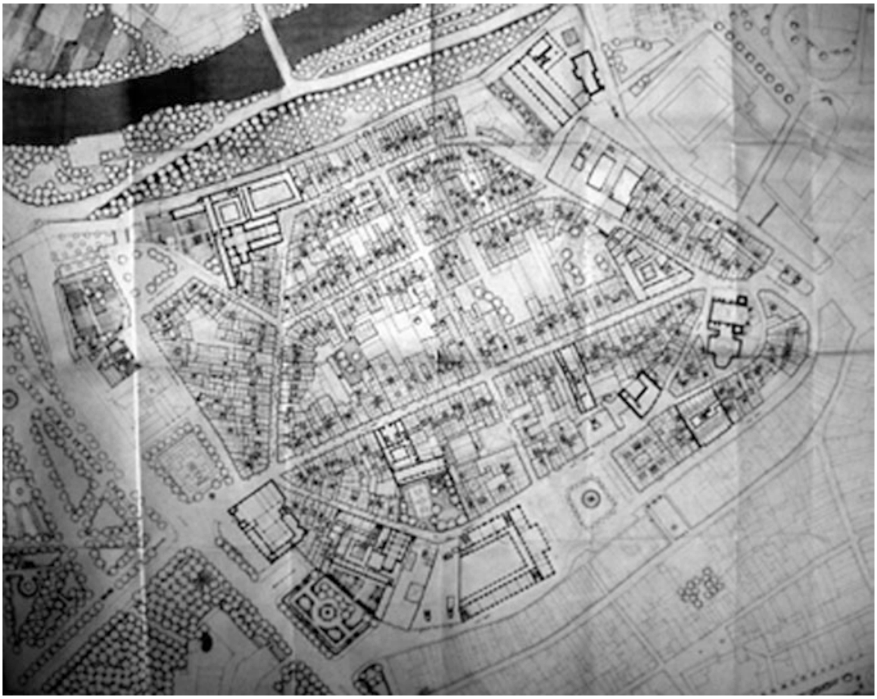

Fig. 7 Plano plant type Brugo PEPRI of San Cernin Old Town of Pamplona

Fig. 8 Perspective Plan proposal that eventually developed the Zizur Urbanization

furniture of the proposal, obtaining a very realistic result and extremely colorful, reflecting a busy urban scene, would achieve convince traders the benefits of pedestrian Center, on which so much reluctance had. In this same line of color proposals that reflect the integration of architecture and public space, we find the proposed Plan of the Citadel, where Redón, with great skill and a huge graphical expressiveness represents each of the plants to be forming different open and closed, public and private spaces in a continuous path of a complex project of urban landscape. As a complement, the perspectives of different spaces show the detail that was designed the architecture of the different spaces (Fig. 9).

In the nineties, new imaging techniques and the application of new technologies will be a big change in the representation of urban planning, which has evolved in this line to this day. The greatest interest in the landscape and the environment, the landscape, the need to regulate the undeveloped land, to define infrastructure has meant that more and drafting the municipal planning is a multidisciplinary work, which is necessary to provide processes share visual documentation. Planning legislation, they are increasingly demanding a greater number of levels to represent the image data of the current situation, proposals and regulatory levels. In addition, the need for digital topographic and cadastral maps and overlay other plannings territorial scale requires the use of CAD software for digital drawing plans. Consequently, plans began to be made in digital formats but presented on paper and A1 formats, the first issue was printed and the rest of copies required by the

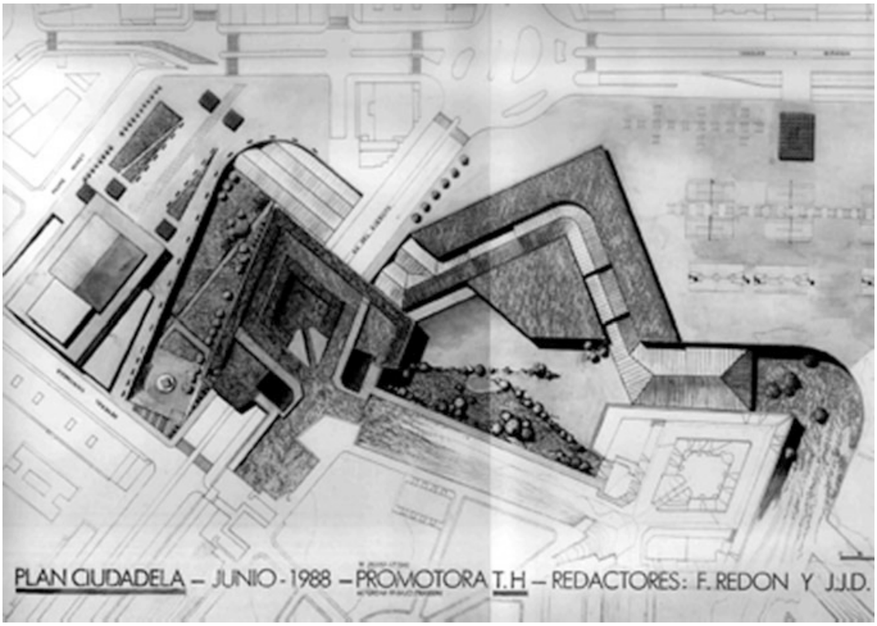

Fig. 9 Plant covers Citadel Plan, F. Redón and J.J.D. Yarza, June 1988

administration photocopied, so that the planes remained with lines and frames in white and black. But the advance of technology has brought down printing, so that most studies came to represent the planes in color, especially those planes that needed to differentiate a large number of entities and required a wide range of colors (plane land use or terms of categories of building land), and instead had to present original copies printed, and even in recent years is admitting submitting copies in digital format (pdf) on CD.

The new century is in the hands of new techniques of graphic expression in architecture based on the software charting and 3D animation, however, these new tools have not been assumed by planners massively and architectural projects. However, the collaboration of architects with technical spatial planning and the environment, has allowed the introduction of other forms of work based on Geographic Information Systems (GIS) for the analysis of spatial and urban cities, the expression proposals for new developments and regulations, but linking them to a spatial reference. These systems facilitate the integration of existing graphical data, overlapping with other plannings, satellite imagery analysis and exploitation of data, but primarily facilitates the sharing of plans or maps created with any user via internet through products such as ArcGIS Online (Fig. 10).

Some regions are promoting the use of these new techniques of representation by adoption of guidelines or instructions for the drafting of planning to normalize the different instruments of urban and regional planning and submit documentation require a data model systematic urban planning, or even using a computer editing

Fig. 10 Detailed ground plane uses the Municipal Plan of Pamplona, 2002

programs so that all plans of different municipalities have plans expressing physical reality and their future growth using the same methods (colors, lines, weights, labels, symbols…) of so that they can be interpreted together, allowing a continuous reading of the urban and regional planning throughout the autonomous region.

As we see, the benefits of systematic planning with GIS tools are many, especially for the dissemination of the planning, which will allow to develop new techniques of interactive participation. However, this standardization leads to homogenization of planning that can lead to excessive quantification and analysis but also a loss of specific urban design values of each place, which gives identity to the city and that may not always be systematized in a palette of colors and symbols or a data table. more human that scale urban design, should continue to be expressed from architectural proposals cityscape, thought and expressed with manual or digital techniques, but since the sensitivity of the architect and having the objective is to achieve a more sustainable city and a space urban quality for its citizens.

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The Drawing Pedagogy Reform in *l'École d'Art* of La Chaux-de-Fonds 1903–1914

Inmaculada Jimenez Caballero and María Alvarez Barredo

Abstract The first years of the twentieth century saw some different efforts around Europe towards new trials on teaching processes in order to join art and industrial production. Art should increase the value of products and it would be a way to impact the social economy. Some countries developed very successful experiences. Some others didn't. *L'École d'Art* at La Chaux-de-Fonds was a pioneer in making some changes to recover its economy based in watches fabrication. Different aspects make these changes and the events around them interesting to the study.

Keywords Drawing · Arts · School

Academic drawing education in the 19th C was not only rooted in the Beaux-Arts and the education of taste, but it also aimed to the training of all kinds of workers (Monthélon 1746, 2). Besides, provincial drawing schools developed a social function, since they provided the provincial elite with access to illustrated culture and with the possibility of sharing it with the crafts, whose "products" were creating their way of life from a double point of view, artistic and economic (Roche 1978, I:154, 127–128).

L'École d'Art of La Chaux-de-Fonds, situated in the French part of Switzerland, was founded in 1870 by the *Société des Patrons Graveurs* in order to train the industrial workers fabricating pocket watches through the apprenticeship of drawing, so they could acquire a better education rather than that obtained at a craftsman's workshop (Renaud 2003). Years later the School became a public institution.[1]

[1]Drawing was a mandatory subject in the secondary French School since 1879 and since 1882 in primary schools, lacking the unity between the two cycles. This pedagogical system had been developed by Eugène Guillaume, former professor at *l'École de Beaux Arts*, from which he took the name and develop in a volume of 455 pages with no illustrations.

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As at the other Schools, teaching methods tried to make use of rational and scientific common language to adapt the necessities of all industries, so there was some confusion between precision and imitation type of drawing, due to the lack of practical exercises that allowed them to understand the efficiency of drawing within its multiple applications (Quénioux 2014) (Fig. 1).

The teaching of drawing had been discussed in the previous years.[2] Owing to the Universal Exhibition of Paris in 1900, the Drawing Professors Association of Paris proposed the organization of the first International Congress about drawing education and the Arts and Sciences.[3] It was since that date that criticism against the teaching methodology used at the time, *Guillaume* method, increased and in the Bern Congress of 1904, Louis Guébin proposed to adopt a more natural method.[4] His ideas broadly spread when they were taken into practice by Gaston Quénioux, professor at *l'*École Nationale des Arts Décoratifs, and this "intuitive" teaching method became widespread in all schools since 1909 (Fig. 2).

In the first years of the 20th C, the School of Arts of La Chaux-de-Fonds gets interesting for several reasons. On the one hand, it reflects the tension established among the different criteria of the many drawing approaches oriented to the development of the industry through the arts. In this sense, the School anticipates a more natural drawing pedagogy. From the Francophone part of Switzerland, it also participated of a similar approach in its neighbour country, Germany, when trying to establish its own stylistic language able to give certain identity to the School and reinforce the worldwide prestige of its artistic productions. It was precisely with this purpose that Hermann Muthesius, who was in charge of the teaching reform of the Applied Art Schools of 1904, would found the *Deustche Werkbund* three years later in Germany.[5]

This paper aims to acknowledge that *l'École d'Art* of La Chaux-de-Fonds was a pioneer in the teaching of drawing reformation throughout its programs. It got two years ahead with the implementation in Switzerland of a similar program to that of Muthesius in Germany, besides, it was the School where the young Charles-Edouard Jeanneret studied. He was a student of the engraving courses between 1902 and 1906 and a singular main character of the reforms that were about to take place at *l'École d'Art*.

[2]During the 17th C and 18th C the discrepancies about the way in which drawing was understood, its teaching, the models and even the different types of drawing was an extraordinary contemporary discussion. d'Enfert Renaud, 2003.

[3]Titled: *Congrès International de l'Enseignement du Dessin, et des Arts et Sciences que s'y rattachent*. In "Premier Congrès International de l'Enseignement du Dessin", Catalogue of the *Cnum Conservatoire numérique des Arts et Métiers*. http://cnum.cnam.fr/CGI/redird.cgi?8XAE501.

[4]Louis Guébin participated in the Congress of Bern as the teaching general inpector of drawing of the city of Paris.

[5]About the relations with the Werkbund see: *Charles-Edouard Jeanneret miembro de l'OEUVRE*. Jimenez Caballero (2015).

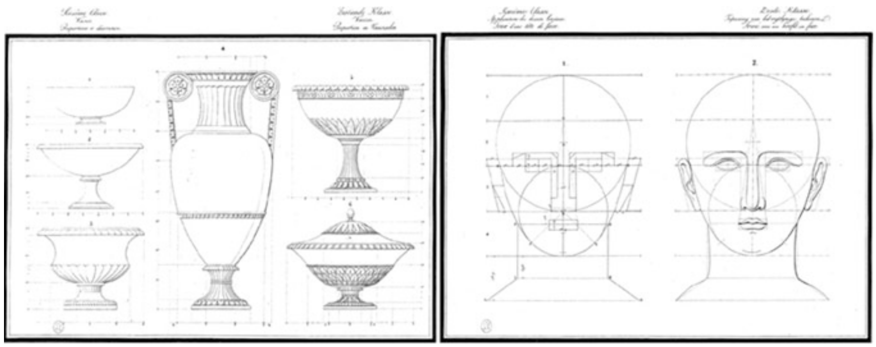

Fig. 1 *Cours de Dessin*. Bruno Renard (1781–1861)

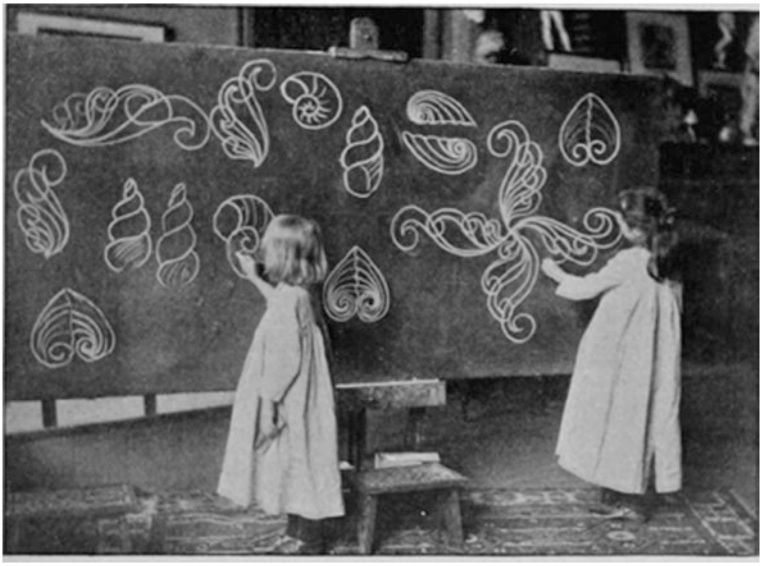

Fig. 2 *New methods in education*. J.L. Tadd

The responsible for that project was Charles L'Eplattenier. His incorporation to the School in 1897 had a bigger goal than the pedagogical one. His aim was to train craftsmen to gain a taste according with the new times and able to provide the local industrial products with an artistic value, this way developing its own stylistic language. He considered architecture as the total work of art. His project of School was not very different from that one of the *Werkbund*, which took place in Germany a few years later, the *Bauhaus* of 1919, sharing the idea that the reform of artistic training constituted the common ground for the transformation of the contemporary bourgeoisie. The necessity of a new aesthetic able to embrace all spheres of common day life and architecture as the art able to integrate within it all the artistic disciplines (Fig. 3).[6]

It was in this sense that a new program was started in order to give a new impulse to the teaching of drawing and in order to promote the implementation of new artistic branches within the School. He was an artist aware of the European artistic movements and of the situation of other teaching centres.[7] He has good relationships with foreigner artists, since he had been trained at the School of Beaux-Arts in Budapest and at the *École National Supérieure de Beaux Arts* in Paris. Furthermore, he had travelled through Italy, Tunisia, London and Germany (Fig. 4).

L'Eplattenier believed that the disappearing of the corporations due to the revolution had provoked the decadence of art. He insisted on how wrong it was to think that copying from the ancient styles would provide a way of life embellishment. He praised the open way in which he had found the authorities of *l'École d'Art* when they affirmed that "La Commission de *l'École d'Art* de La Chaux-de-Fonds, soutenue par nos autorités a compris, il y a quelques années qu'il était d'une grande utilité pour notre ville de favoriser l'enseignement de branches artistiques autres que celles de la décoration de la boîte de montre" (L'Eplattenier 1910).[8]

Charles L'Eplattenier started his reform with the creation of a new course, of which he would be the head, in 1905, the *Cours Supérieur de Décoration*. It was a course on decorative composition that aimed to increase the design quality of the boxes for watches, which were suffering from a drop of their sales. He was trying this way to stimulate the young students' imagination by providing them with new "destinies" for their artistic work.[9]

The course objectives were: orienting the youngsters' vocation towards new "destinations" outside the craft of watches industry, the theoretical study of the arts and the execution of practical works in which it could be able to integrate the different crafts. For the first time, a real collaboration between artists and industry

[6]The difference was that the *sapin* style wanted by L'Eplattenier continued to be rooted on the artistic principles of *art nouveau* whereas the Bauhaus was searching for a totally new aesthetic within the different artistic movements.

[7]He and his collaborators knew at least well Pforheim founded in 1887, Nacy in1901 and the project of Hellerau that reached its fulfilment in1912; each of them with its own characteristics, they served as model for his project. Charles L'Eplattenier, Ch.-E. Jeanneret, Léon Perrin, Georges Aubert, 1914.

[8]He developed these comments and ideas in "Renouveau d'art" *l'Abeille Suplément du National Suisse*, no 2, La Chaux-de- Fonds, February 20th in 1910.

[9]*Extraits des procès verbaux de la commission de l'École d'Art* Bibliothèque de la Ville, La Chaux-de-Fonds, Fonds Le Corbusier, LC/101/864 Nd-82.

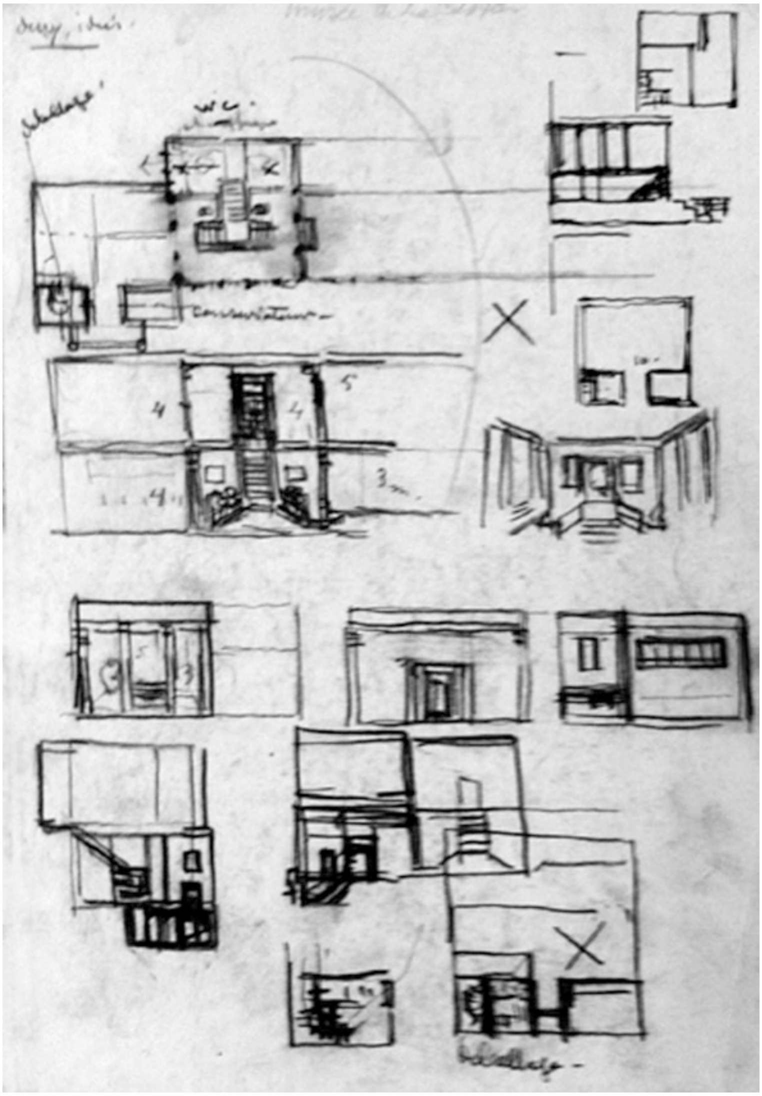

Fig. 3 Architecture's sketches, L'Eplattenier's students

was proposed, with some desire of modernity able to develop a local character. It is this new approach of incorporating the practice within theoretical studies that would be later introduced in other Schools (Fig. 5).[10]

[10]The *Deustche Werkbund*, German organization born with the same purpose, would not be founded until 1907. The parallelism existing between the action programs and the activities makes us think in a relationship between L'Eplattenier and member from the former German organization previous to his arrival to the La Chaux-de-Fonds, as the one he maintained with the architect Alphonse Laverrière.

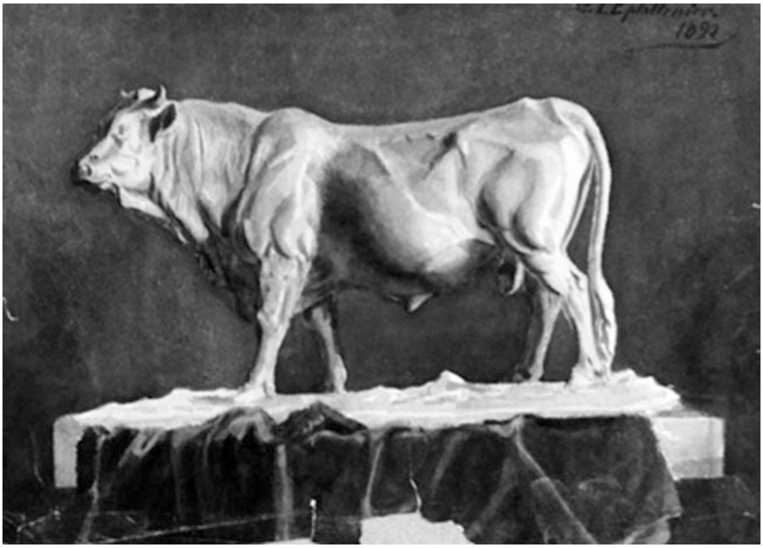

Fig. 4 L'Eplattenier's work at *École de Beaux Arts*

His pedagogical method tried to introduce a personalized teaching dependent on each student level of training, capacity and the chosen artistic discipline. It was precisely this personalized method that led the young Jeanneret towards architecture, as it had guided other students to different disciplines. This model of personal supervision and the new way of teaching theory and practice gave birth to the execution of real works by the students that constituted an extraordinary emulation effect and contributed to stimulate the spirit of research of the first twenty students registered. The many works developed together with the students confirmed the excellence of this system.[11]

L'Eplattenier had from the beginning a singular group of student to start. With the approval of the school three former students of the *Cours Supérieur* Gustave Aubert, Léon Perrin and Ch.-E. Jeanneret founded the *Association indépendante des Ateliers d'Art Réunis* in 1910 in order to execute the demands of works of all kinds coming from several artistic disciplines.[12] This association was reproducing similar models founded several years before in Glasgow, Darmstadt, Munich or that of the *Wiener Werkstätten*. As it was the case of the *Werkbund*, recently created,

[11]Between 1906 and 1910 the students of this course did almost one ten of works focused on the construction of a house, the interior decoration, music rooms, design of the decorative elements, works of restoration or big interventions as that of the crematory of the La Chaux-de-Fonds, the post office or the observatory of Neuchâtel. Since 1910, not only the commissions of the local region were develop at *Les Ateliers d'Art Réunis*, but also those from Lausanne or Genève.

[12]L'Eplattenier presented this proposal to the *Comission de l'École d'Art* that unanimously approves it, *Procès-verbaux de la Commisssion et de Bureau de l'École d'Art de La Chaux-de-Fonds* September 17th in 1908, pp. 278–279, Archive of *l'École d'Art*, La Chaux-de-Fonds.

Fig. 5 Students sketches at *Cours Supérieur*

their protagonists also tried some sort of a life in common, in the middle of nature, isolated from all influence and focused on self-reflection and debate. They participated of a common ideal and they started a commune of artists (Brooks 1997; Dumont 2006) (Figs. 6 and 7).[13]

From this moment on, every commission received by the *Cours Supérieur de Décoration* naturally passed to be executed at the *Ateliers d'Art Réunis*. The former was in charge of the theoretical training and the later executed the practical work. They were in charge of developing the commissions following the contemporary

[13]Jeanneret and other members from *Les Ateliers d'Art Réunis* rented an old farm for a while far from the city, placed in the middle of the mountains and in which they remained isolated from time to time due to weather conditions (Brooks 1997; Dumont 2006).

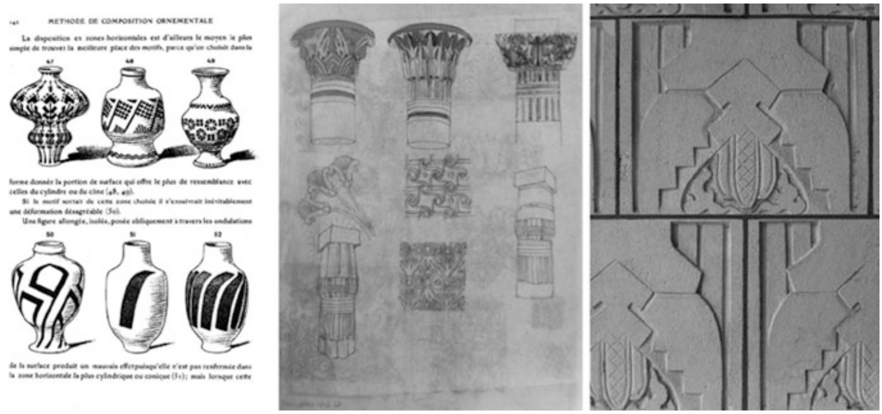

Fig. 6 Grasset's theory and workshop practice at *Cours Supérieur*

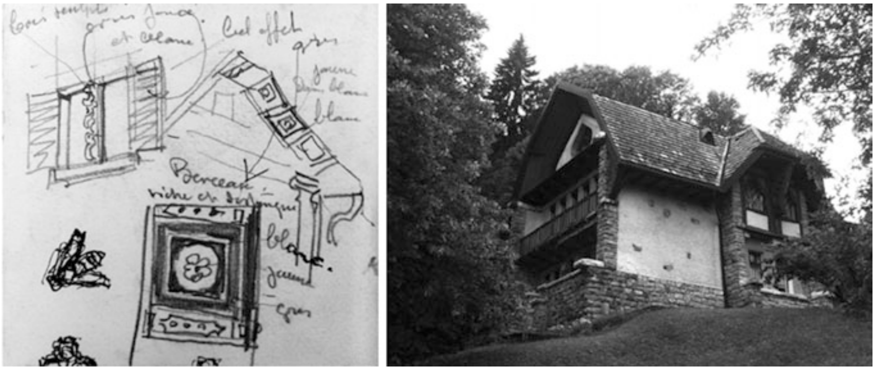

Fig. 7 Some crafts studies to integrate into architecture

stylistic trends and for this purpose, the master encourage them to travel to different prestigious places because of their products so they would learn other ways for performing their craft. This project of teaching reform at the *l'École d'Art* is at the core of decisive episodes throughout the training of the future Le Corbusier: his trips to Italy, Paris, Germany or Dresden (where in those years Hellerau would be built), ought their being to the ambitious initiative of L'Eplattenier (Daza Caicedo 2015).

The success of the new program allowed L'Eplattenier's project for a new building for the school and for the *Cours Supérieur* to be discussed at the session of the *Commission de l'École d'Art* on September 17th in 1908. The commissions needed a new working space where workers and apprentices could work together.[14]

Jeanneret drew his well known sketch for the building of the *Ateliers d'Art Réunis* in 1910, two years after the proposal of his master. Although it was never built, the rooms for the *Cours Supérieur* and the spaces that the artists' group needed were placed inside an old hospital on the Numa Droz Street, due to its disposition by the communal authority.[15] It is easy to imagine the discussion brought by the identification of the *Cours Supérieur* with the *Ateliers d'Art Réunis* when they were enclosed in a separated building from the *l'École d'Art*; an autonomous school head by L'Eplattenier and his disciples, advised to travel in order to reach the next step of his project.[16]

In 1910 L'Eplattenier designed the pedagogical structure for *La Nouvelle Section de l'École d'Art*. The initiative was well received, since it has been approved with a majority by the *Commission de l'École d'Art* on June 12th in 1911 and ratified by the *Conseil Communal*. Its objective was to train young people in a type of drawing related to each one's chosen artistic activity after they had finished primary school. They try to turn the city into a locus for artistic life for the whole country, helping this way the creation of new industries that increased the building standards. Simultaneously, it aimed at the creation of a well trained faculty in the art of drawing.[17] It substituted the *Cours Supérieur* and it was composed by two courses with four teachers: L'Eplattenier in first year and the students Aubert, Perrin y Jeanneret in the second (Fig. 8).

The purpose of this program was essentially practical: a methodical and theoretical pedagogy hand in hand with a great production in the decorative arts, so they could compete with the invasion of foreign products, clearly more advance as it had been shown by both the market and the universal exhibitions.[18] The *Commission de l'École d'Art* requested from Jeanneret a report on the applied arts in Germany, so this new *Section* could be started (Fig. 9).[19]

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[14]*Extraits des procès verbaux de la commission de l'École d'Art* Bibliothèque de la Ville, La Chaux-de-Fonds, Fonds Le Corbusier, LC/101/864 Nd-82.

[15]About this association of artist lasting up to 1916, Cfr. Hellmann Anouk, 2002. The aspiration of having its own building designed in accordance with its new teachings constitutes one more commonality with the Bauhaus.

[16]The *Procès-verbal* of *l'École d'Art* in May 16th in 1910, L'Eplattenier proposes the total separation of the *Cours Supérieur* of *l'École d'Art,* which will give birth to the *Nouvelle Section;* furthermore, Ch.-E. Jeanneret would be proposed for being commissioned in a trip to Germany in order to make a report on the estate of teaching and the applied decorative arts in that country. He will write the *Étude sur le Mouvement d'Art Décoratif en Allemagne* published in 1912.

[17]As it was proposed by the Bauhaus, the idea of architecture as the total work of art was from the beginning in the conception of L'Eplattenier, and also in the same way, after a more ideal and romantic first stage, a new step will be taken towards a bigger production of works.

[18]En *Nouvelle Section de l'École d'Art*, *La chaux-de-Fonds, Prospectus*, Son But. 1912, Imp-Haefelli & Co, La Chaux-de- Fonds (CH).

[19]The work would be edited in 1912 with the title Étude sur le Mouvement d*'Art Décoratif en Allemagne* Jeanneret, 1912.

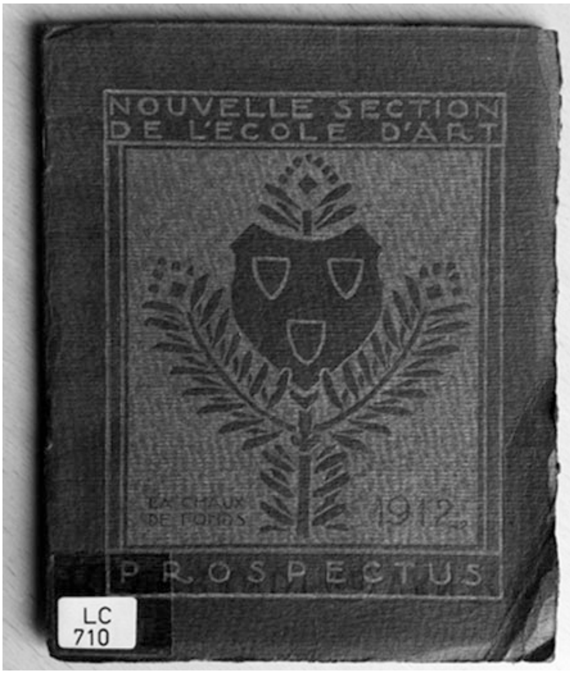

Fig. 8 *Prospectus*

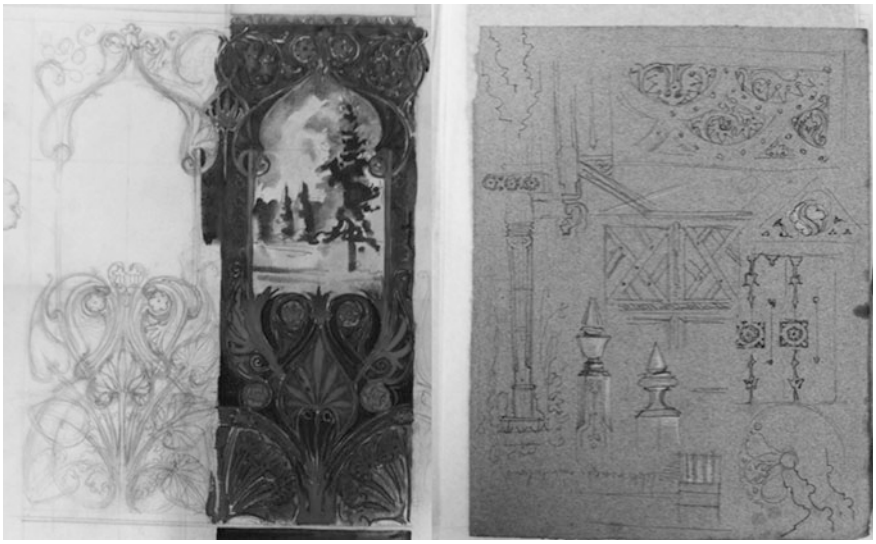

Fig. 9 Some exercices belonging to *Nouvelle Section*

Following the study program, Charles L'Eplattenier was in charge of first year. In this course it was studied life drawing, the human figure, animals and landscapes; the application of drawing to decorative composition, mural composition, posters, stained glass windows, decorative and monumental sculpture, medals, etc. entitled the aspirant for the official teaching of drawing and an examination was needed to enter the school.

In second year, Aubert was in charge of drawing and modelling, the reasoning study of form in nature and wood sculpture; Perrin, of ornamental composition, of finding decorative elements in nature and of the study of forms and colours; finally, Jeanneret was the head of the geometrical elements and their application to architecture, to furniture and other objects, and also of the practical execution of architectural works, of the interior decoration and of different objects.

With no need of an exam to enter this course, it was oriented towards the different artistic specializations and the student could start at any time of the academic year, this way attending different workshops. While learning, students were allowed to accept professional commissions and since the school was placed within the old hospital donated by the *Conseil Comunal*, it was open all day long.

The most traditional sectors opposed *La Nouvelle Section* from its very beginning. The rivalry among the veteran professors against L'Eplattenier and his group dated back to 1905, when the design for a watch by the students of the *Cours Supérieur de Décoration*, broadly criticized by the most conservative part, won the first prize in the International Exhibition of Milan in 1906. The increasing number of students applying to enter the *Cours Supérieur* was also a topic of discussion (Fig. 10).

The argument got worse when the promoters of the *Nouvelle Section*, against the implementation of his pedagogical model, appealed to the necessity that each school should follow only one model. At this time, the professors of the *Ancienne Section* were threaten by those young students with almost no experience and who had been promoted by them. If they were in favour of one and only school, it was precisely theirs the one to be erased.

The socialist party, which in 1911 was fighting to acquire the political local power, found in this discussion within *l'École d'Art* a strong argument for its purpose.[20] The local press made public the disagreement about the teaching methods at the school.[21] As it was the case of the Bauhaus, it was the political forces, although of an opposite wing in this case, the ones to put an end to a

[20]The socialist party positioned itself with the more conservative branch of the school, because the renewal was believed to belong to the few elite obsessed with luxury. Some misunderstandings rekindled the rivalry among the council members, who believed some of them to have succumbed to a few artists' desires who wanted to make use of *l'École d'Art* as if it was of their own. Cfr. Charles L'Eplattenier, Ch.-E. Jeanneret, Léon Perrin, Georges Aubert, 1914.

[21]The accusations between the member of the two branches of *l'École d'Art* could be followed through the published articles in the *National Suisse* since August 26th, 1911, to the end of the same year. Also during April 1914 in the *National Suisse* and *La Sentinelle*.

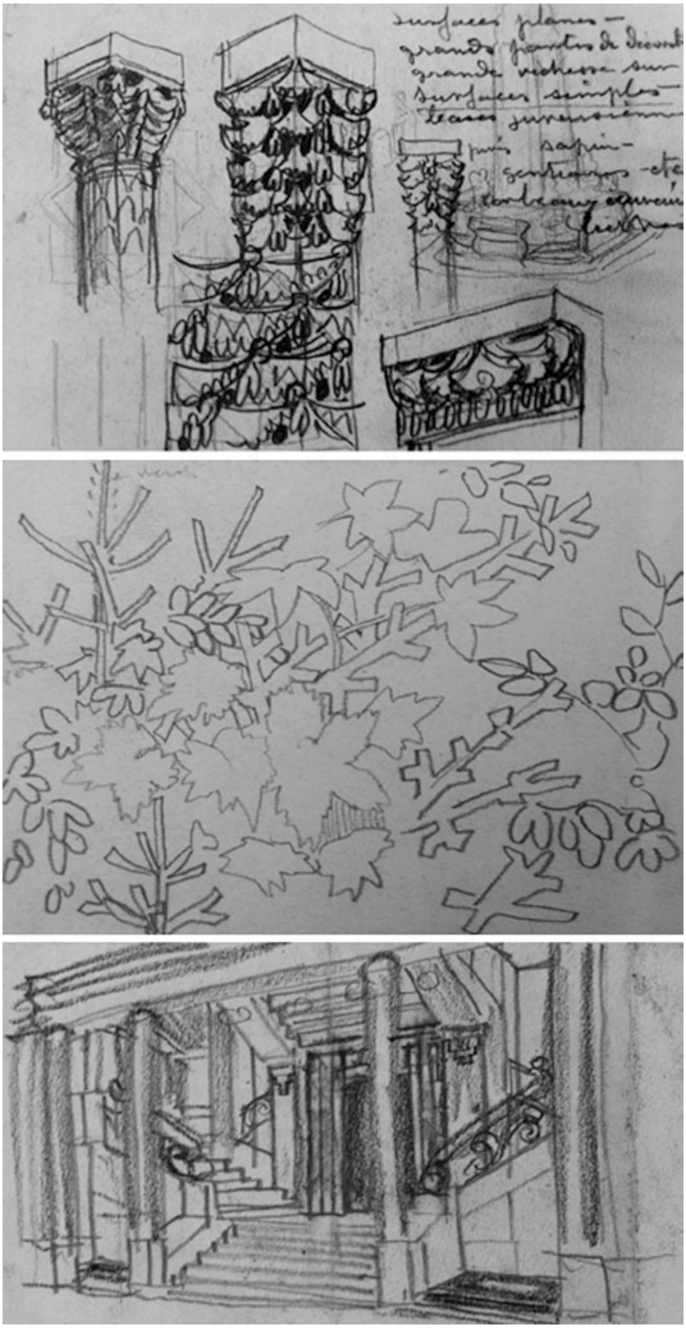

Fig. 10 Some exercices belonging to *Nouvelle Section*

movement of artistic renewal based on new pedagogical approaches in the schools of art.

The attempt by this group at *l'École d'Art* of La Chaux-de-Fonds leaded by L'Eplattenier could have had a bigger importance in the renovation of the decorative arts and its drawing teaching methods during the first decade of the 20th C. The confusion between public and private institutions, the professional jealousy; the unavoidable comparison of the obtained results and the interference in the internal affairs due to the several reports sent by some members of the *Werkbund*, previously asked by some member of the *Nouvelle Section,*[22] ended this great effort that only lasted for fifteen years. It could not be forgotten the ideological discussion and the pre-war ambience in this part of Switzerland because of the fear to the imposition of certain ideologies under all these artistic ideals.

As a consequence, L'Eplattenier resigned on March 18th in 1914 and one moth later other three professors resigned, this way putting an end to the ambitious initial project and to the effort of all those years[23].

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[22]The professors of the *Nouvelle Section*, in their attempt to keep the school open sent several letters to famous characters, of major prestige, asking them to judge the pedagogical methods of the school. They were Eugène Grasset, head of *l'École d'Art* in Paris, Ernst Osthausm Alf Roller and Theodor Fischer executive members of the Werkbund, Peter Behrens honorary member and Hector Guimard.

[23]On the 2nd of April, the professors of the Nouvelle Section submitted to the Council a report about the efficiency and necessity of their program; a week later the *Commission de l'École d'Art* left in the hands of the *Ancienne Section* the decision about the continuity of the school, so the teachers decided to resign.

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Revisiting *Civitates Orbis Terrarum*. The Urban Space Spectacle

Felipe Lazo-Mella

Abstract A recursive graphical resource in the representation of an urban space in the contemporary touristic thematic maps is the mix of paths with some iconic elements presented in a zoomed axonometric, perspective or elevation view. In order to explore the origins of this resource in the creation of an image for a touristic city, this work review four drawings of Barcelona in the XVI century; three by Anton Wyngaerde and one by Jan Cornelisz Vermeyen that illustrates the *Civitates Orbis Terrarum* World Atlas as the first *global* image of the city of Barcelona.

Keywords Civitates orbis terrarum · Urban tourism · Digital humanities

1 Introduction

The relevance of tourism in a city such as Barcelona has generated several thematic maps from its official tourism agency, Barcelona *Turisme* (Fig. 1). These [maps] have been modified to represent the landmarks based on demand studies, which at the same time are driven by the offer in a circle of information and action based on images. According to reports from Barcelona *Turisme*, venues of architectural interest and museums represent the highest amount of visitors. And in the top ten of unique visits within the old city is the *Born* Cultural Center (associated with the

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E. Castaño Perea and E. Echeverría Valiente (eds.), *Architectural Draughtsmanship*,
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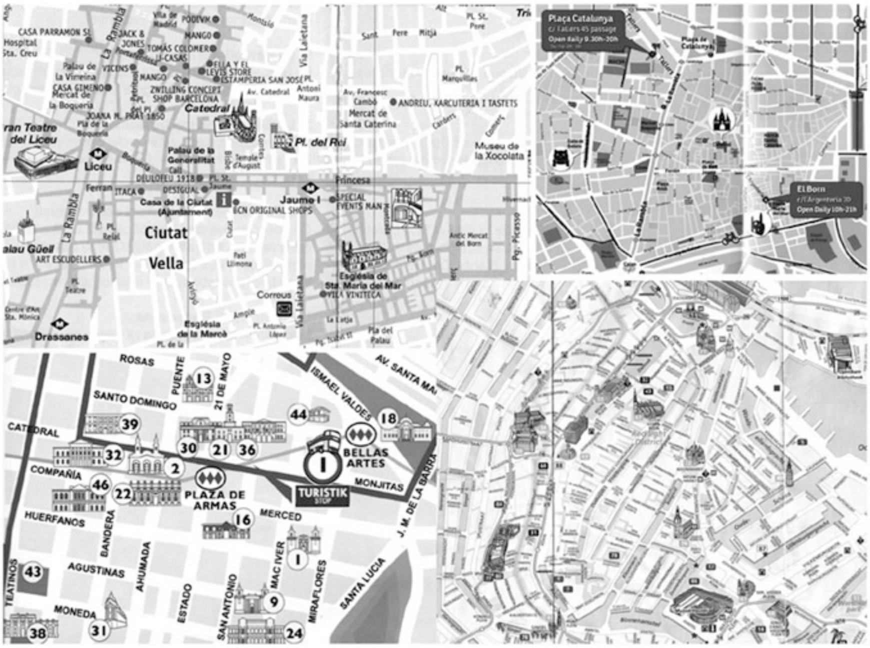

Fig. 1 Tour maps. From *top* to *bottom* and from *left* to *right*: Barcelona Shopping Line (Barcelona Tourism), Barcelona Bike Tours (Barcelona Tourism), Santiago Turistik Map (SERNATUR), Amsterdam Free Map. *Source* Digitalized Printed maps

neighbourhood and the Cathedral of *Santa María del Mar*) and the Barcelona City History Museum (associated with *Plaza del Rey* and the Roman original settlement, *Barcino*).

The first global image of the city of Barcelona dated from 1500, where a number of elements are distinguished as representative of the city in order to create a pictorial view that is an interpretation of singularities of the city to be communicated (as a chorographic exercise). This character is not much different from contemporary tourist map, which is focused on topological relationships rather than on exposing physical distances (many maps show graphical scale only as a convention), all this with a goal; to guide visitors from one point of interest to another point of particular interest.

As for mobility, we know that the arrival to the city in 1500 was mainly by sea and by foot, horseback or carriage inside the city. Nowadays, in terms of tourist transportation, dedicated tourist buses takes the highest percentage of use—which pursues points of interests, followed by cable railway—which pursues the panoramic-view. Through these means of transport, the city is presented for the casual traveller as a synthesis of these two scales. A study of the image in the Flickr community (Donaire and Galí 2011) shows that the panoramic image of the city takes a large percentage of the sample as well as the vast majority of photographs of unique venues show nodes and buildings in context, realizing that the rescued and effectively communicated image of Barcelona is bounded by scenic and transport.

The Grand Tour—Activity recognized as a forerunner of the modern tourism—recorded tours focusing on several European destinations being the most frequent France and Italy. The last one was the most important destination in the seventeenth century, due to Rome, which received a century before important visitors of the Renaissance humanists as part of their studies of the classical world. These written and pictorial records held by humanists and nobles are an important part of the development of architectural representation to be part of the work of Brunelleschi, Alberti, Palladio, among other prominent architects of the Italian Renaissance.

With the Catholic Counter-reformation cultural revolution, a strongly development of scenic image of the architectural facade and its spatial context in Italy; a show that defines the image and recurrent representation of the city as wanted to be seen and that is synthesized in an image projected to the world; architectural and urban spectacle is put in place at the beginning of Baroque style ordered for this purpose; it is a paradigm shift towards the visually extravagant and immediate in replacement of the visually balanced and timeless of the High Renaissance.

In this context, influential works are published such as Theatrum Orbis Terrarum (Ortelius 1570) and later, as a complement, Civitates Orbis Terrarum (C.O.T.) (Braun 1572) presenting an unprecedented visual spectacle through a collection of views and plans of urban spaces in their contexts. In 2009 a complete version of C.O.T. is republished (Braun et al. 2009), then Cartografía de la Ciudad (Schüler 2011a) reaching the twentieth century and gathering works of Geographia by Ptolemy, Chronicles of Nuremberg (1493) and Hartmann Schedel Cosmographia (1544) Sebastian Münster as well as the same *Theatrum*... and *Civitates*…, among others.

2 Scenographic Sequence. Analysis Method

In every period, urban spaces have been used as a scenery in which citizens take part as protagonists and spectator. "Urban life is nothing but theatrical" (Kostof 1991).

The theatrical scenery image and representation of Renaissance and Baroque urban space have something in common; they are compositions of visual elements for a type of imaginary space that serves as a background for predefined actions of a character. This way, Renaissance and Baroque representation of the city, although assumed as an object itself, they are still a type of composition that considers the visual embedded elements in the intellectual vision of the author and his intentions.

These aspects were part of the route and recognition that made flamenco artist Anton van der Wyngaerde in the sixteenth century with the mission of representing in one image, the entire city of Barcelona at that time. Drawings that now we know do not precede but proceed the drawing of Jan Cornelisz Vermeyen who later takes part of the C.O.T. from the work of the engraver Franz Hogenberg (Garcia i Espuche 1995).

This way of understanding urban space thereafter the drawing is formalized in the twentieth century by Gordon Cullen; a relationship between urban design and the organization of visual elements as a sequence that constitutes a visual experience; useful to evaluate the readability of an urban space.

It is necessary to synthesize the first representations of the city to identify the elements' connections that first the author—Vermeyen and, later on, Wyngaerde—expressed in their drawings the task of creating a representative image of the city. For this matter, the first known views of Barcelona are redrawn, including one that is part of the collection of views of C.O.T. World Atlas, focusing on the highest and especially detailed constructions of each drawing, including the general layout of the elements of the natural landscape, the streets and spaces that can be observed. In this case, pictorial details of the chorographic description are being left behind due to the topological character of which the present study is deduced from (1).[1]

3 Revisiting Barcelona of the C.O.T

Anton van der Wyngaerde was hired by Philip II for a graphic inventory of major cities and fortified points of the kingdoms of Castile and Aragon. He left a collection of 62 drawings in which there are views of Barcelona, Madrid, Toledo, and Cordoba, among others. Barcelona drawings were made in one or several trips during 1563.

From the series of drawings of Barcelona *Wyngaerde*, the first sketches from the sea are a sequence that forms a wide panorama as a tour of the coast (Fig. 2), taking in account the visitor's arrival, highlighting the port activity and the walls of Barcelona, leaving out in this first draft, the *Montjuic* representation. As a result of being the first sketches, the characteristic elements of the city were not yet apprehended. Therefore, these are representations that synthesize mainly a visual perception, mostly corresponding to a frontview or flat composition with some depth by superposition where some prominent elements are presented—besides the completed wall—such as the dockyards and the towers of *Santa María del Mar*.

In the next two drawings, the *Montjuic* stands out as a distinctive visual element and observation point, the watchtower on top shows this condition at the time (Figs. 3 and 4).

In Figs. 3 and 4, a non-technical mix between axonometric and conical projections as a composition with different vanishing points and a high horizon in a compound pictorial plane to show the Barcelona of the time behind the walls is

[1]See Millán Gómez, et al. (2012). Organic and Inorganic Overlapping in Old Barcelona. For more information on the topological analysis method, refers to the theory of Space Syntax.

Fig. 2 1563 Barcelona drawing by *Anton van der Wyngaerde*. *Source* Atlas of Barcelona (Galera 1982a). Digital retrace: Felipe Lazo—Mella

observed; a large graphic compression of the left end of the drawing make the *Monjuic*, area Raval and Rambla look like minor visual elements in comparison to the center of the old Barcino and the most characteristic buildings of the era such as the Cathedral of Barcelona or Santa Maria del Mar, which occupy the center of the composition. The wall is shown much more extensive in the *Riviera* zone, it is possible to appreciate the proportional difference of the metric scheme in the diagram plan of the sea wall at the time. (i Espuche Garcia and i Guàrdia Bassols 1986). Compared to Fig. 2, *Portal de Mar* and *La Merced* stand out.

An important difference between Wyngaerde's drawing (Fig. 4) and Hogenberg's engraving (Fig. 5) is the horizon. The second is the deformation at the edges of the city and its wall; The *Rambla* is depicted as a big curve. Another broad difference is that Wyngaerde's view presents more information; access and axes remain evident. The foreground is an axiom of the character of each image; while on first one the top of *Montjuic* is represented in a descriptive way, in the other one it a couple represent a theatrical scene where the is a scenography.

In Fig. 5, the walls have a much smaller scale and therefore visual hierarchy. The view is supposed to be closest to the city and at a lower altitude and, in turn, presenting a much clearer skyline. At the same time, it becomes very difficult to distinguish the streets and roads within the city, considerably away from Wyngaerde's vision who is closest to the plant and contemporary resources

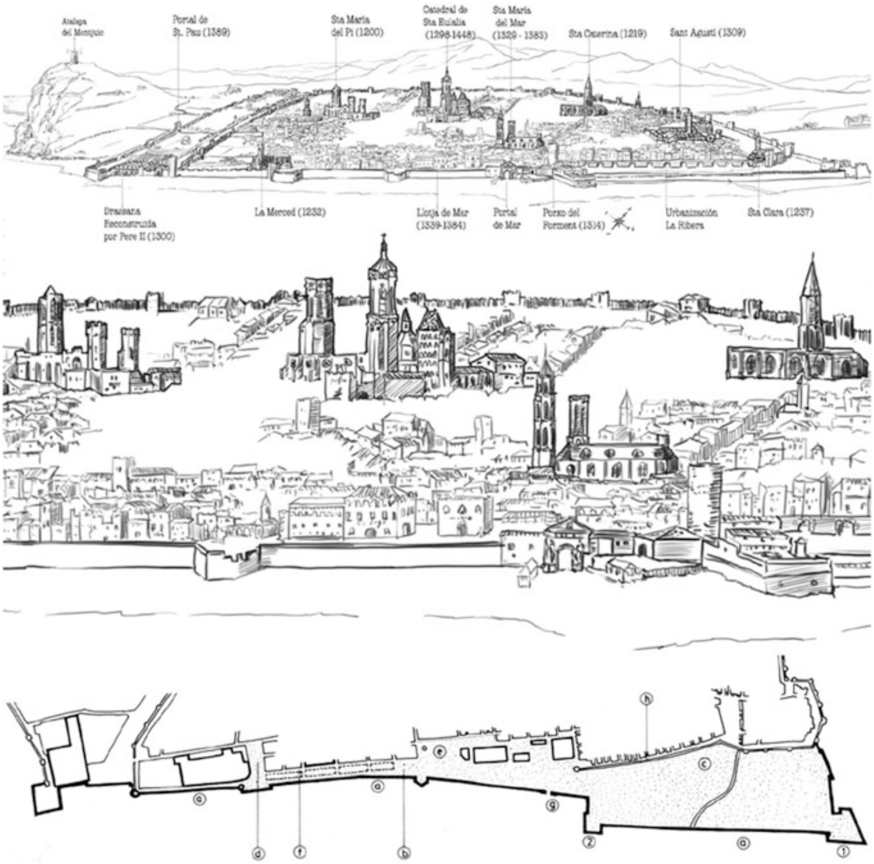

Fig. 3 *Above* Barcelona of 1563 by Wyngaerde. View from the Sea. *Source* Self elaboration based on the reprinting of Barcelona's Atlas (Galera 1982b). *Below* Plant of the sea wall in 1500 in real proportion. *Source* Garcia and Espuche (1986)

(Figs. 1 and 9). This view uses a higher percentage of space in the representation of the environment and its expressive elements, the city is generally less detailed, while rural areas, mountains, and the sea acquire more relevance. The graphic synthesis shows that the number of empty spaces corresponding to areas unbuilt and minor construction without detail is higher compared to that of Wyngaerde's, even though both period and observation point, are near.

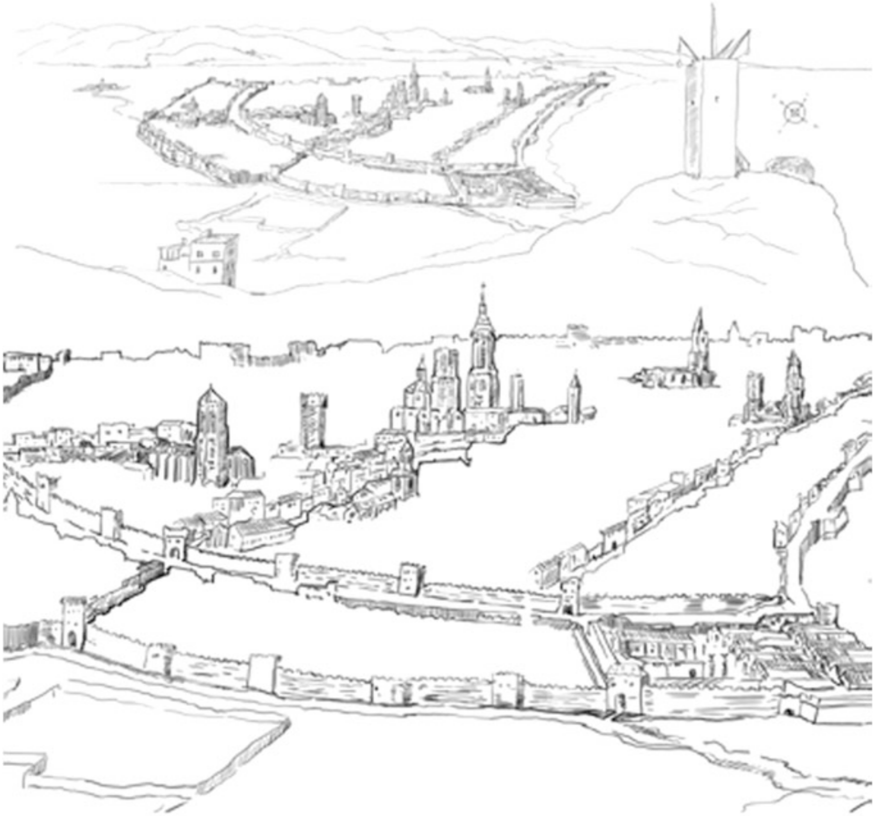

Fig. 4 1563. Barcelona. Anton van der Wyngaerde. View from *Montjuic*. *Source* Self elaboration based on the reprinting of Barcelona's Atlas (Galera 1982b)

4 The Topological Image

Any city or device that embraces human activity should be developed on oriented surfaces, likewise the main graph representing the physical network should be flat. This condition affects both the study of settlements and their representations. But duality affects our approach in other ways: secondary graphics representations often are not flat (requiring some simplification or further elaboration).

An urban network can be decomposed into axial shaping maps graphs where nodes are lines and edges are intersections between lines (Millán Gómez et al. 2012) (Fig. 6).

Cities tend to have a universal global basis (large-scale) as opposed to a local specific form of culture. This is locally patches or cluster of streets. In the case of Barcelona, the result of topological analysis meets the definition of historic districts and drawings featured in 1500 (Fig. 7) milestones.

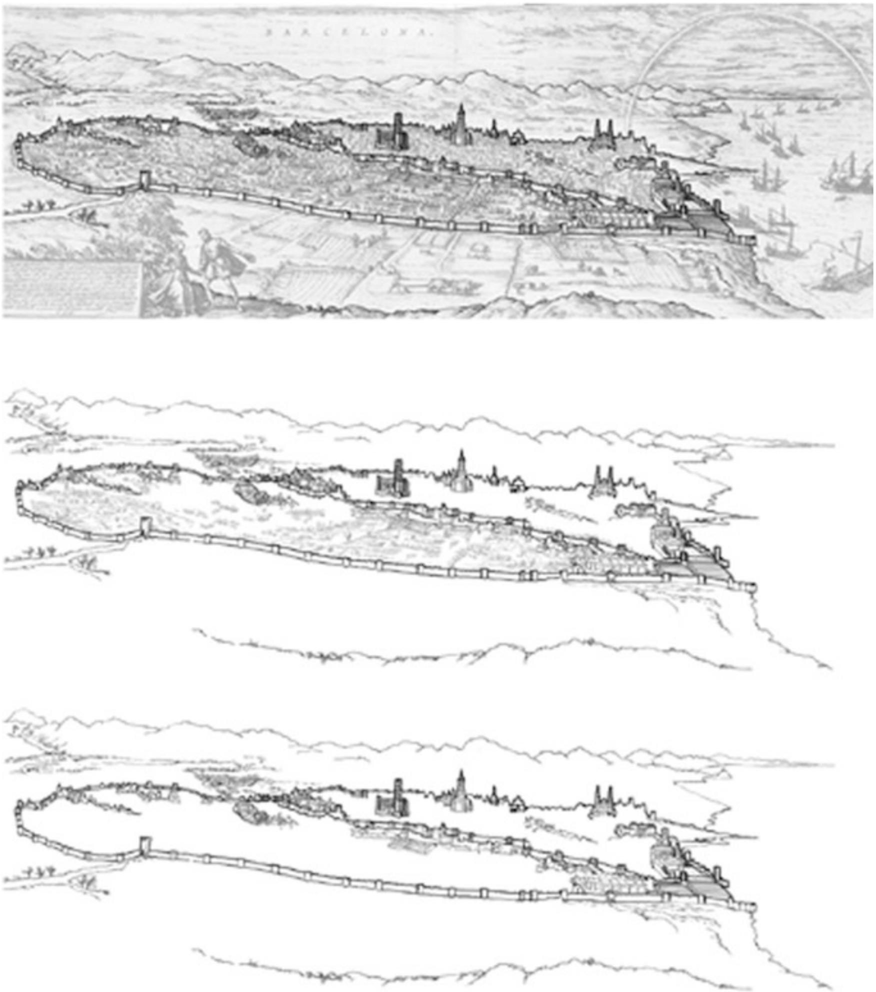

Fig. 5 Barcelona (Drawing, 1535 Jan Cornelisz Vermeyen. Engraving, 1572 Franz Hohenberg). Special attention to the *Portal Sant Pau* with its external path. Limits, geographical location, cathedrals, watchtowers and harbour with the dockyards are highlighted, the main rural condition of the *Raval* area and of course the condition of *Montjuic* viewpoint. In the center, just as Wyngaerde's drawing, is the Cathedral of Barcelona (*Santa Eulalia)* and *Santa Maria del* Pi are found. *Source* Compiled from the reprint found in *Cartography of the City* (Schüler 2011b)

The local and global development coincides with the local economy as well in neighbourhoods and large structures were intended to trade on a larger scale at the harbour (Fig. 8). Wyngaerde recognizes Barcelona from the sea from the first sketches (Fig. 2) the second most elaborate drawing (Fig. 3) recognizes the dockyards and the promenade (*Rambla*) respectively, possibly guided by the previous observation of Vermeyen's drawing which highlights the same elements (Fig. 5).

Fig. 6 Topological synthesis plane Barcelona1439. *Source* Millán Gómez, et al. (2012)

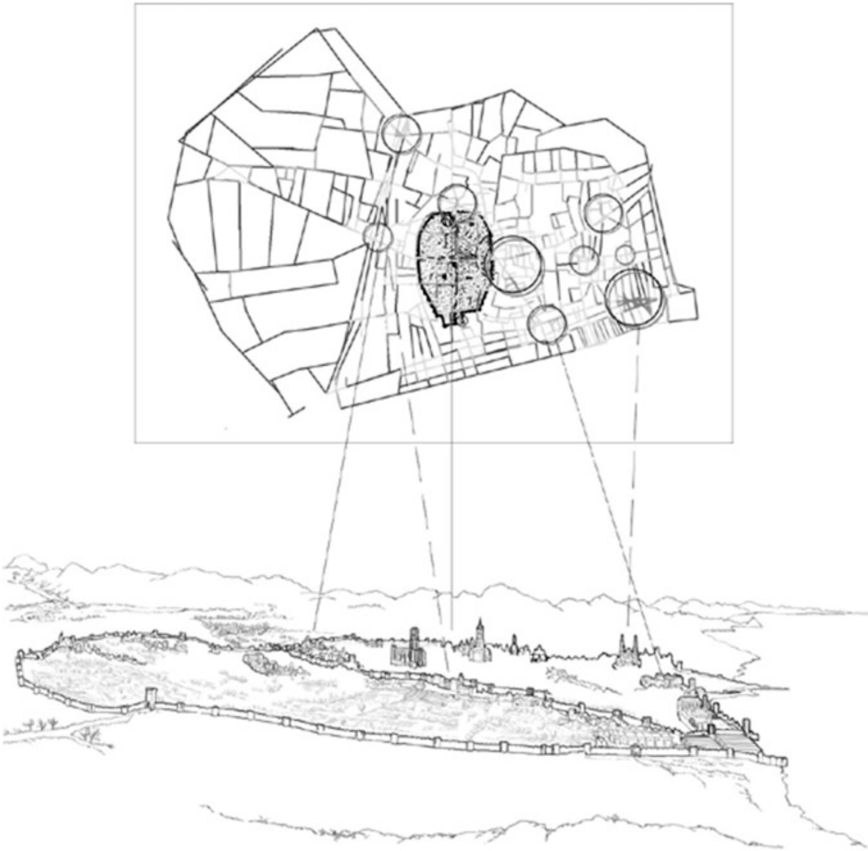

Fig. 7 The relationship between the topological points of Barcelona and prominent places in the engraving C.O.T. *Source* Millán Gómez et al. (2012)

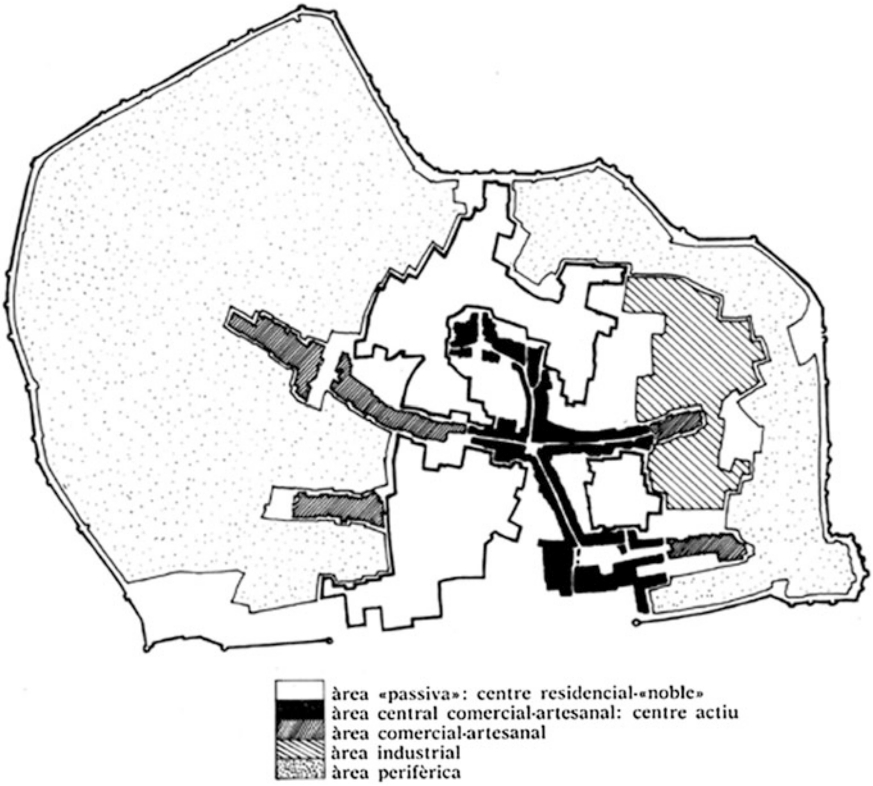

Fig. 8 Synthesis of profession's distribution in Barcelona from 1500. *Source* Garcia i Espuche and Guàrdia i Bassols (1986)

We note in Figs. 3, 4 and 5, numerous points of graphic emphasis that match with points on the plan of greatest concentration of local integration (shorter and concentrated streets that meet at sharp angles and can be accessed more directly compared to the rest of the grid), however we can notice how all the emphasis on the detail of the dockyards and the port's limit does not appear prominently in the topology synthesis as it is shown in the drawing. We can say that the drawings are strongly influenced by the image rescued in his arrival to the city, bounded by the means of transport, an image that is more global than local and coincides with the character of C.O.T. However, even with strong deformation rate and form of the elements presented in different views (See metrical scheme Fig. 2), the graphic expression recognizes effectively the topological links of the central elements, making them not only unitarily distinguishable but in the context of urban space as well.

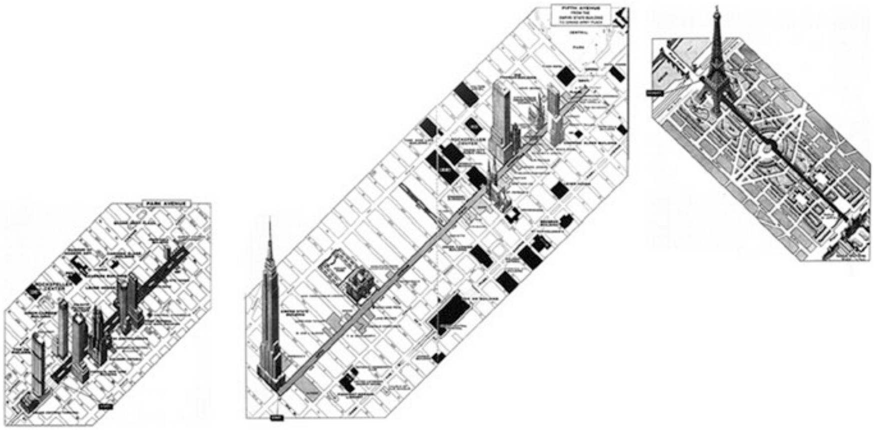

Fig. 9 Graphics resources of contemporary tourism. Between maps and axonometric perspectives. *Source* Wurman (1971)

5 Conclusions

Projection techniques, disseminating and normalizing through the time opted for technical formalities that go beyond formal and informal representations, being these diagrams, maps, or other perspectives. However, the character of graphic synthesis's massification of convention graphic resources pursuing monosemantic does not really differ in function to recreate a constructed reality, which can not be seen in its whole. Wyngaerde made several preliminary drawings of Barcelona, experiencing plans and views from sea and land—moving forward to expressive resources and leaving behind the representational ones, as a mixture of undefined axonometric cavalier projections with some banishing plans. The first views were unable to summarize the city (despite its size); finally, he opted for a view from the *Montjuic* that becomes iconic—and it is useful for many subsequence works from other authors who require representing Barcelona. The observation of the authors led them to this high place from where the settlement can be controlled visually, carrying out the challenge of creating a single image to represent the entire city. It is quite possible that Wyngaerde meets with the prior Vermeyen's drawing and just as contemporary traveller he was seduced by that view and wanted to replicate it with his pen to have his own version. It is the same informal technique—powerfully expressive—that is observed in most reproductions of various authors in the engravings of C.O.T.; where several chorographic views resemble thematic maps rather than perspectives.

These actions reflect a desire to move towards a re-reading and re-significance of historical graphic records of the city to be integrated, for example, diversity and specification of a type of tourism that not only recognizes separate elements as monuments, but places as well, together with contexts and connections between themselves, such as that streets network, spaces and squares that foster encounter and failed meetings and that are an important part of that rescued image that each visitor can carry in their mind and their camera.

The route to the final drawing marks an exploration pattern that is not only physical but also conceptual in the selection of graphic resources where the city finally appears as a background, a scenery and a scenography for life that debates between rural and urban clearly identified by the walls and in the density behind the wall, identity through reference buildings and their visual and spatial connections arises.

6 Beyond the Civitates Orbis Terrarum

During the Italian *Settecento*, the rise of the pictorial representation of the urban landscape puts *vedutismo* especially and the city of Venice in sight—especially through the catalogue of 14 engravings in the *Prospectus Magni Canalis Venetiarum* (1735). A feature of these pictorial expressions is that they possess a high level of technical precision, so high that even being artistic perspectives, are almost cartographic records to be in a direct relation between these views and the metric plane (between *ichnografia* and scenery in Vitruvian terms). At that time, these views were well known to be consumed by travellers as a souvenir of the visit, constituting the ancestor of the modern postcard. Already located in this analogy, *vedute* reproduced views with the most typical places of Venice, including monuments, thus reinforcing the positioning of these spaces, views, and buildings as the representatives of the place, constituting also the ancestor of the modern destination image.

Two centuries later literature *Townscape* was a phenomenon especially in England of the mid-twentieth century, it began with the *Town Desing* Frederick Gidberd in 1953 and then the famous townscape by Gordon Cullen in 1961. Cullen defined, according to Camilo Sitte, planning as the "art of relationships", focusing their analysis on historical components in the serial vision, awareness of the human scale and what Cullen called "content" that considers the perception of space (Kostof 1991). Cullen above all was an artist, and analysis techniques of urban space are based on a drawing that transcends times, even on his writings (Fig. 9).

Today, the graphic images of urban tourism positions using resources in urban space show to attract visitors based on a series of nodes comprised of resources, attractions, products and services based mainly on a mainly planimetric image of the city destinations—tourist Map. The aim of future studies reveal ought to be in the timeless logic of graphics resources, the way we see, think and represent the city as a whole when this city was not due to its modern layout, but its spaces, limits and symbolic constructions; the timeless content of these graphics resources as a graphic synthesis from historical and current publications, discovering to what degree these relationships are discarded in setting standards graphical representation—today accepted without protests, reinterpreted through new media representation of public space following the entry of digital media. Thus, the study of historical chorographic representations as those of C.O.T. and its associated images regain a new sense as part of a development of an urban tourist imaginary.

We must then consider a complementary and parallel visual development to the functional, especially when a graphic material for the special interest tourism is developed, one that considers variables exploring the view of the possibilities to observe and at the same time understand, imagine and to enjoy the urban spectacle.

Today the tourist image has a symbolic weight associated with the consumption of it over the material object; we consume images associated with experiences and share them with others as trophies. Here the importance of the media and information and communications technology.

In this context, increasingly has more sense to revisit those graphic expressions of the places that have changed or remained from the preindustrial context not only physically but also ideologically in order to understand what makes up the rescued and represented image of the city, also the ones that have been, are, and could be their diffusion broadcast media.

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Drawings of the Guastavino Company: Innovation and Promotion

Manuel De Miguel Sánchez, María Paz Llorente Zurdo and Vanessa Antigüedad García

Abstract John Ochsendorf, in his book, *Guastavino Vaulting*, says that the patents of this valencian builder, settled in the United States during the last decades of the XIX century, are not original contributions. Although some builders may have been using such a system in Spain at the time, "Guastavino appears to have been the first to treat it as a modern, standardized system, using new materials and rigorously detailing the construction methods" (Ochsendorf 2010, 155). The father and son devoted significant time to develop technical and technological innovations. They achieved an advantageous position in the market due to their exclusivity in the construction of vaults in the late nineteenth century. And they achieved a great prestige among the leading architects, belonging to the American Renaissance, in the early twentieth century. The timbrel vault, first seemed to be just a light constructive solution, economic, and fire resistant. Then it became a hallmark, appreciated for its aesthetic qualities and its image of consistency and durability. There is a large bibliography about the achievements of Guastavino's Company, that analyzes them in constructive, structural and even commercial terms. However it is important not to forget that many of the buildings, in which Guastavino's vaults were included, have been characterized by the configuration of the space that they provide (Collins 2001). It is a combination of efficient construction, structural challenge and a spectacular image. Drawings of calculation, layout and detail of these vaults show clearly their rules of construction and include graphics that explain the performance of its structure. They try to show an image of transparency and honesty in construction. Both, drawings of patents and promotional posters

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fulfill that task, conveying sincerity. The commercial skills of Rafael Guastavino Jr. complement his father's manner of working, implementing structural and acoustic improvements, without losing his technical rigor. The aim of this paper is to study several drawings published by the Guastavino Company, analyzing them from the graphic and architectural point of view. For this we turn to the sources of the original publications. We will study the graphic context, so we can understand the visual impact that the images sought to produce, both to potential customers as well as the general public.

Keywords Rafael guastavino · Patent drawings · Timbrel vaults

The Guastavinos, father and son, put their best in the development and application of technology in building of the timbrel vault. To achieve their goal, they do not agree just to improve in the field of construction, but they also devoted great efforts to the development of numerous documents for the spread, published in several media, where graphic components were essential.

These documents lead to three main areas: advertisement, industrial development, and scientific documentation. The advertisement posters, were widely disseminated, either through journals in the architecture and construction field, or through editions by the company itself. The collections included photographs and drawings of their greater accomplishments. Some of the projects, as we shall see, were redesigned and transformed into generic models in order to facilitate the inclusion of Guastavino's details on the projects of others architects.

With a mainly industrial purpose, highlights their registration of patents, of which they came to carry out twenty-four of them in the United States, between 1895 and 1939 (Redondo 2000). These documents began only as an efficient way of raising the visibility and consistency for the building system in cuestion, but soon they become one of the keys for the Company's success. Rafael Guastavino senior achieved to have exclusivity in construction of timbrel vaults nationwide. The drawings in the patents offer an interesting sequence of the evolution of Guastavino's way of work, both from technological innovations that were implemented, as well as the thinking of their authors. The correlation between the two processes figures out a great will of coherence on the contributions of the company to the American building industry.

Also very important were the Guastavino's scientific writings. Publications and lessons that came to complement the Guastavino's working site, providing the necessary scientific support to the design and calculation of its ambitious vaults. In fact there was a gap in the treatises about building on timbrel vaults and it was necessary to undertake such a task in accordance with the theories at that time (Huerta 2001). The cultural component in the late nineteenth century in the United States became an engine for social change. Through his contribution to knowledge and culture Mr. Guastavino became a respected member of the society of his time (Loren 2009).

The hypothesis of this paper is that such documents, particularly their drawings, are connected by a common intent. It could be said that many of them aim both: technical and commercial objective, with the same efficiency and at the same time. Business, artistic and vitalistic impulse go together in Guastavino's enterprises. And that combination is showed in each step they make to succeed in their technically audacious and professionally ambitious works.

1 The First Drawings Published

Rafael Guastavino Moreno arrived to the United States in March 1881. His first contacts with the American graphic diffusion media were through illustrations for the magazine The Decorator and the Furnisher. For this he would make, during those early years, different designs. They range from the representation of complete spaces, as seen in the image of a lavishly decorated bedroom (Fig. 1) to the design of furniture in different styles. Between them highlights a set of seats (Fig. 2) that the author suggests according to occupy spaces.

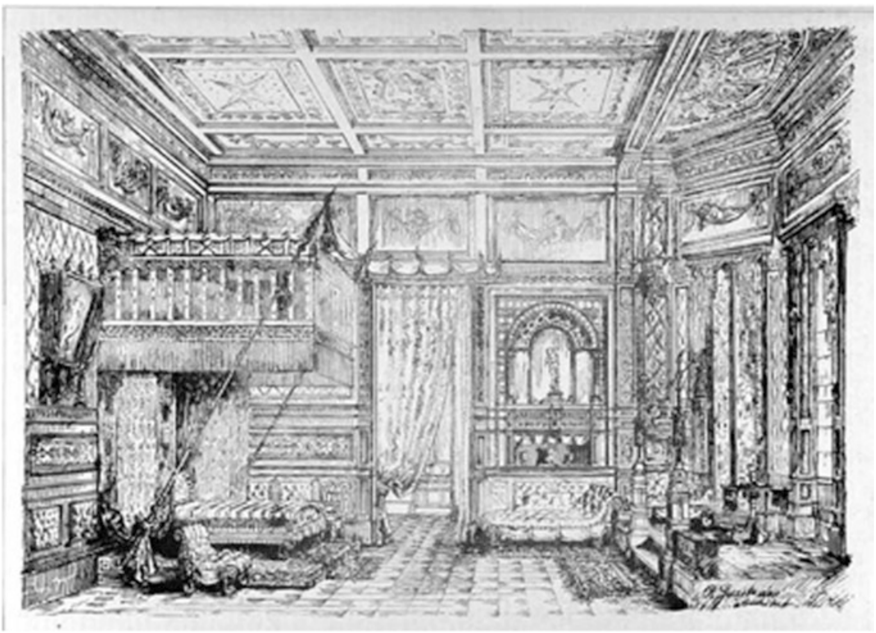

Fig. 1 Rafael Guastavino Moreno, 1884: *Design for Furnishing and Decorating of Bedroom*. Fuente: The Decorator and the Furnisher, volume 5, October 1884

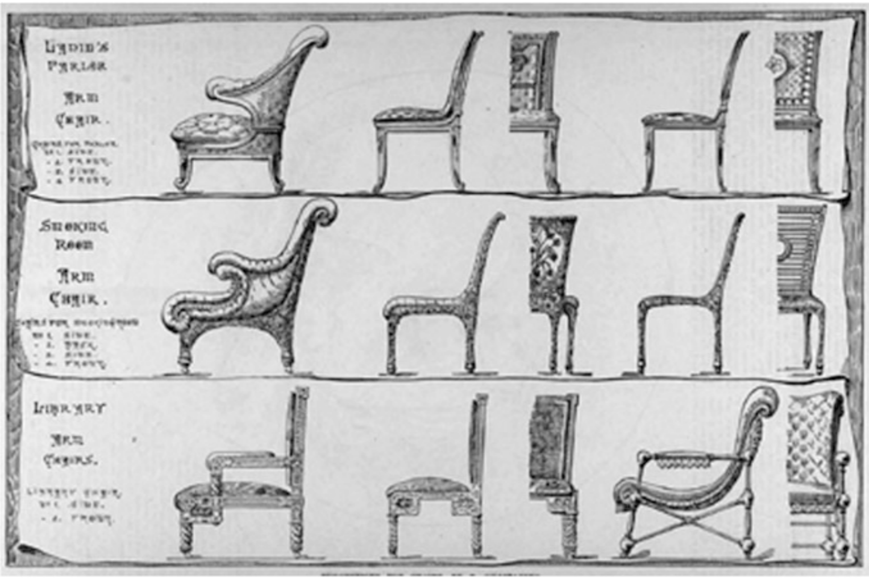

Fig. 2 Rafael Guastavino Moreno, 1885: *Suggestions for Chairs*. Fuente: The Decorator and the Furnisher, volume 6, p. 53, May 1885

It is evident that Guastavino's ability to propose solutions that fit the tastes of the time. His first commissions as an architect evoke shapes that recall historical precedents, exotic memories, attractive for his contemporanean American burgeoning society. He was able to illustrate their projects, full of details, in Moorish, Byzantine, Greek styles, etc. Showing great consciousness in construction and decoration.

Therefore the growing of fashion styles associated to the Beaux-Arts movement of the late nineteenth century in America was a great opportunity for Rafael Sr. In 1893 the World Exposition in Chicago was a boost for the American architects trained in the French École (Ochsendorf 2010). Guastavino participated in the fair as the designer of the Spanish Pavilion, a Neo-Gothic work, clearly inspired by a valencian ancient building called *La Lonja.*

2 About History of Construction

As a builder Guastavino senior had a strong background in traditional ceramic construction. He acquired it as a disciple from Juan Torras Guardiola as well as through his own experience in Barcelona. Among his works of this stage, highlights the dome of Centro La Massa in Vilassar de Dalt (Bassegoda 2001).

The recovery of classic styles involved the use of the vault in all its versions. This was an opportunity to get positions in the construction market. The alternative offered by Guastavino, as a builder of vaults, was to value the structures of brick, cheaper than masonry. Although first he found difficulties because of the shortage of ceramic materials and skilled labor, soon his experience and tenacity led him to success in several key works and then his product started to be very appealing to the US construction industry.

The timbrel vaults can be raised without formwork. The bricks can be built almost "in the air". Just a few planks and ropes are enough for a geometric control. The thickness of the vault is another of their striking features. Compared with arches maid of stones or reinforced concrete, emerging material at the time, this kind of vaulting has something mysterious and surprising, an innovational challenge to gravity (Collins 2001).

The Company was able to value such assets. Their contribution could be just some well done constructions inside a group of buildings. But the Valencian builder boosted his chance looking towards the progresses of his time and incorporating them into his technic, the timbrel vault. "The Guastavino's achievement was to use a vernacular procedure, widely used in popular architecture in Catalonia, which are the timbrel vaults, to transform it into a modern construction system, by incorporating new materials, mainly portland cement, instead of mortars of lime" (García-Gutiérrez Mosteiro 2000).

The International Congress of Architects was held at the time of the Columbian Exposition in Chicago, in 1893. Then Guastavino sr. presented a paper called The cohesive construction, its past, its present, its future. There he reproduced fragments of his Essay on the Theory and history of cohesive construction (Fig. 3). The Spanish architect Mariano Belmar, present at the conference, spread the Rafael's American achievements, upon his arrival in Spain. Years later Luis Moya, in his treatise *Vóvedas tabicadas*, included a note of admiration for such work (García-Gutiérrez Mosteiro 2001).

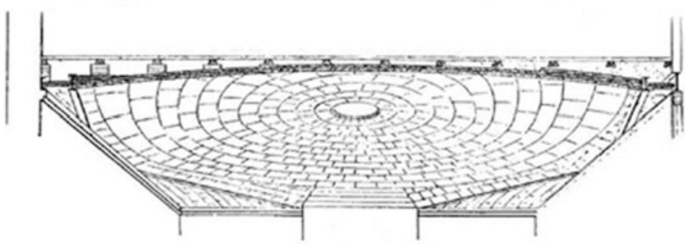

Fig. 3 Rafael Guastavino Moreno, 1893: *Essay on the Theory and History of Cohesive Construction Applied Especially to the Timbrel Vault*, 128. Ticknor, Boston

3 Patent Drawings

The concern about the devastating fires that occurred in the late nineteenth century, was remarkable in America. Interesting proposals for fireproof building systems came from Europe. Hyatt patents, were registered in England in 1877. Hennebique system, first established in Belgium and France in 1879 (Gulli and Guastavino 2006). Guastavino's reaction was immediate. He registered his first creations, at the eighties, not as masonry construction, but as Construction of fire proof buildings (Fig. 4). They show structural elements such as stair structures and vaults to solve all kind of spaces.

Guastavino was a man of his time, keen to profit the improvements available. He was aware of the latest technical developments and adapted them quickly to his business project. The fire protection was the first idea on which he put to work. Another great challenge was the structural progress. The widespread incorporation of steel on buildings soon led Rafael to deepen its relationship with brick.

The use of steel in Guastavino's Company evolved quickly. He implemented tie-rods into the brickwork. Is evident the importance of their meaning in the text by the author "I use tie-rods of iron, the material best adapted for resisting tension strain". It is not possible to say he was using what we call now "prestressing" but his drawings are a surprising approach, in a starting way, to the huge potential this

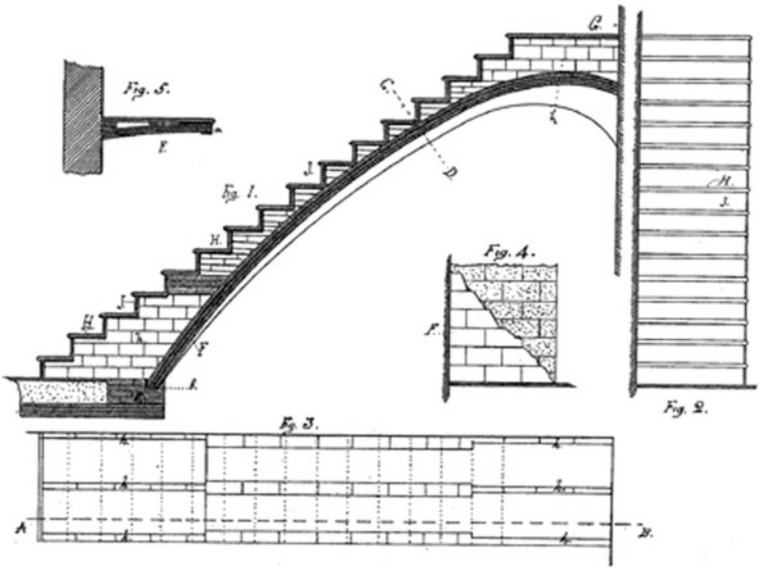

Fig. 4 Rafael Guastavino Moreno, 1886. *Fire Proof Building*, 01. Fuente: US Patent No 336047, February, 1886

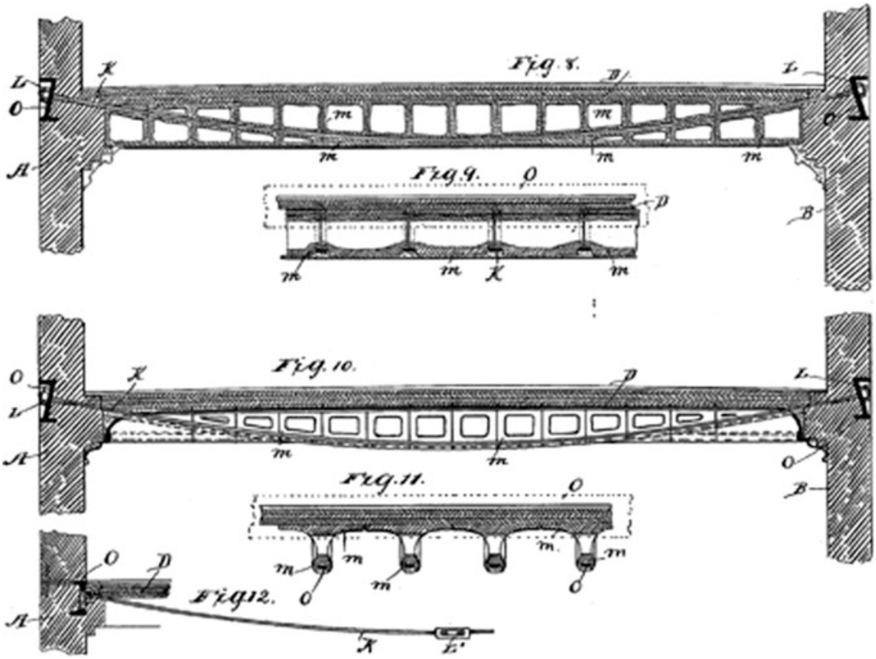

Fig. 5 Rafael Guastavino Moreno, 1886. *Construction of Fire Proof Buildings*, 02. Fuente: US Patent No 336048, February, 1886

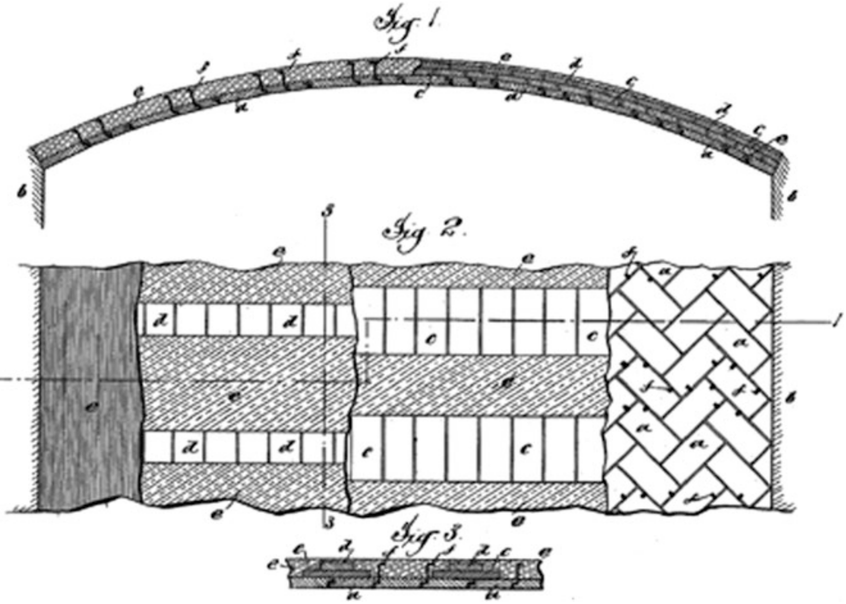

Fig. 6 Rafael Guastavino Expósito, 1892. *Construction of Fire Proof Buildings*, 01. Fuente: US Patent No 468871, February, 1892

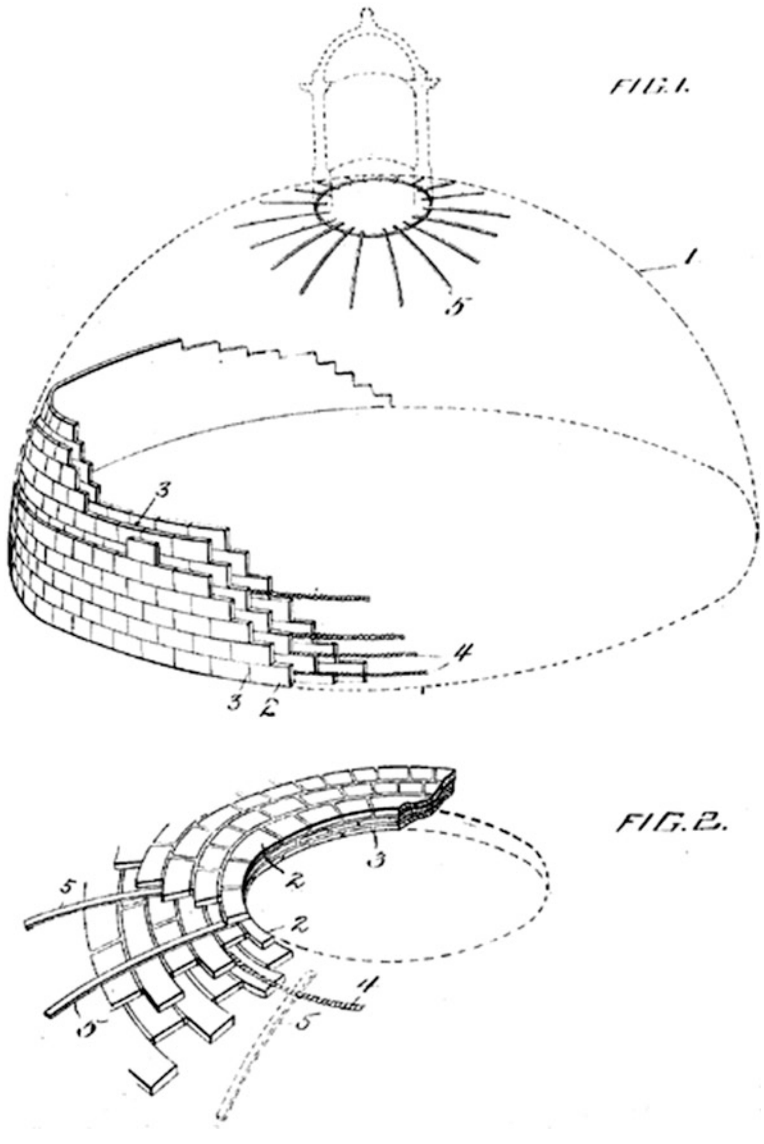

Fig. 7 Rafael Guastavino Expósito, 1910. *Masonry Structure*, 01. Fuente: US Patent No 947177, January, 1910

technique would have in the future. Some of the patents incorporated steel rods, within the ceramic itself, working in tension against the horizontal forces. Guastavino understand that the form can be controlled by tensions imposed from the outside of the structural element. One of the main references in the US about prestressing is Jackson's patent called "Improvements in girders" (US Patent No 126396), dated 1872. Far from comparing this patent with Guastavino's, signed in 1886, is interesting to underline that both of them have an conceptual similarity (Fig. 5), and they appear in a very short space of time.

The next step comes almost naturally and steel becomes integrated gradually into brickwork as fine bars (Fig. 6). Because the Company had incorporated since start Portland cement, as the basis of his system, steel corrosion is controlled properly, because of that positive combination. Again intuition becomes technique and can be considered as an great achievement of what now is known as reinforced brickwork. Deepening in the same line, Guastavino junior registered in 1910 Masonry Structure. This project included steel wires into brickwork in several directions (Fig. 7) trying to provide a complete response to all types of elements in construction, such as domes, walls and floors.

Guastavino junior's drawings did not have the formal audacity of father's projects, but they showed a remarkable ability to improve the technology that made possible to undertake greater challenges. Longer spans, proper systems, more precise and accurate specifications for materials, were implemented by Guastavino's son. The aim followed throughout his career was to convince customers that the ceramic solutions have several advantages, such as fire protection, structural and formal consistency and all of them at a very competitive price for that time. His achievements included improvements in the absorbency of ceramics. These acoustic features were some of the most important technological advances of the system.

The posthumous patent of Guastavino senior, dated 1909, was called Structure of masonry and steel, (Figs. 8 and 9) and intends to serve as a model to build all kinds of social reference buildings: museums, libraries, shopping malls, etc. Large equipment that would have a major space covered with a monumental dome. Rafael ends his career, proposing the shape of the building as a real justification of his own system. Even adapting uses and types to the geometric layout of dome. Regarding, in a certain way, Durand's lessons in the french academy, one hundred years before. Thus he is closing a round trip from the progressive improvement of a traditional system, transforming this into something different, through a personal touch, and finally proposing a complete, perfect, closed system.

Guastavino junior, had applied his talents to improve the system to levels of remarkable sophistication, although he was less intuitive than his father about breakthroughs in building systems. Instead his business acumen was not lower and his company was present even several decades after his father's death, in the projects of the best firms in the country. For years the Guastavino's advertisements appeared in journals, such as Sweet's cataloge. In the offices of the American architects it was a common reference the Guastavino's detail sheet (Fig. 10)

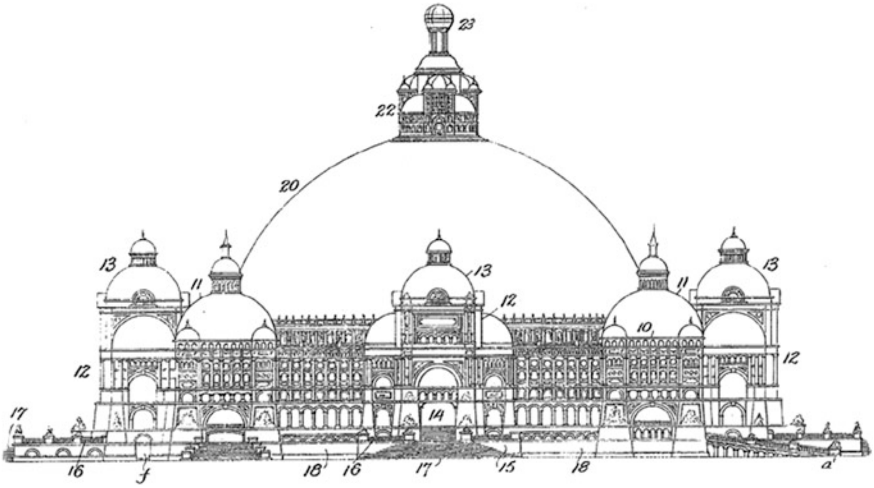

Fig. 8 Rafael Guastavino Moreno, 1908. *Structure of Masonry and Steel*, 01. Fuente: US Patent No 915026, March, 1909 (a título póstumo)

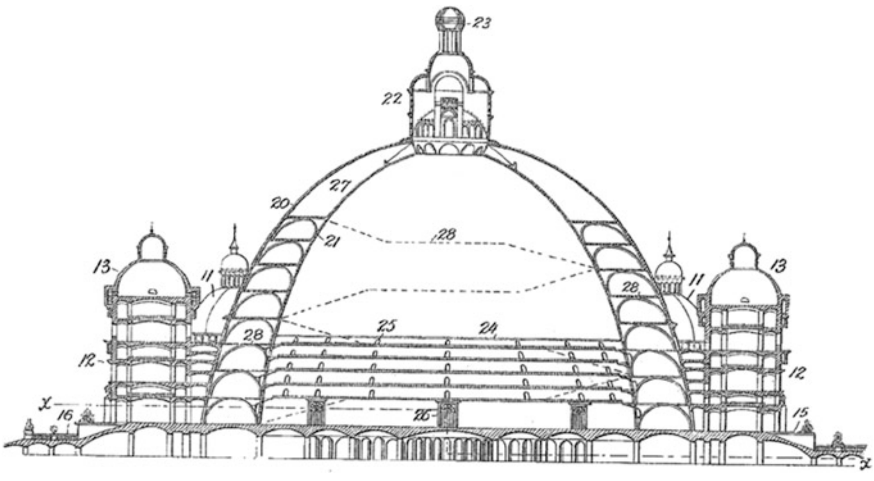

Fig. 9 Rafael Guastavino Moreno, 1908. *Structure of Masonry and Steel*, 02. Fuente: US Patent No 915026, March, 1909 (a título póstumo)

inspired by some of the projects carried out at that moment. Rafael junior published annually designs in order to inspire architectural projects. So some of the architects used to take directly these detail sheet, including shamelessly the Guastavino's brand in their technical specifications (Ochsendorf 2010).

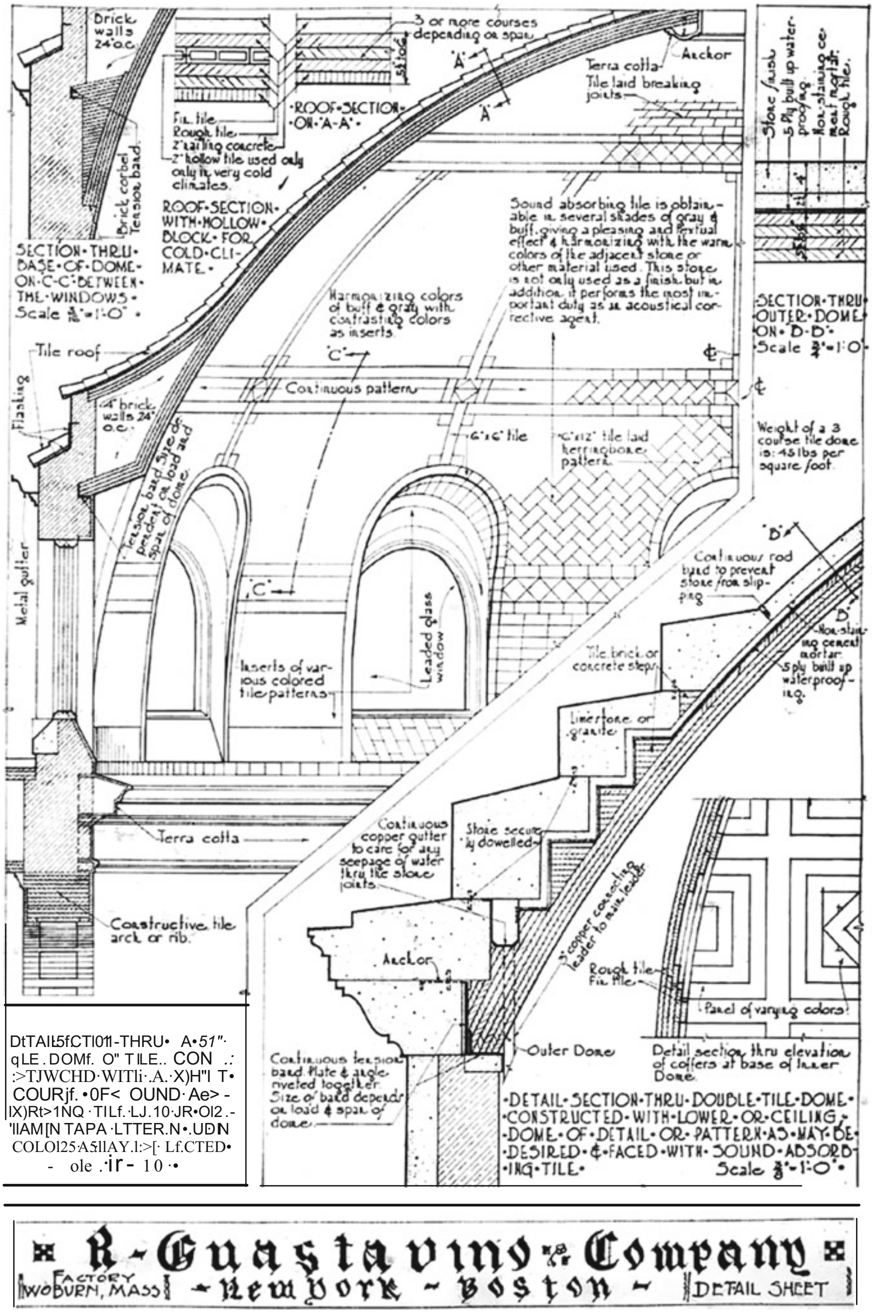

Fig. 10 Rafael Guastavino Expósito, circa 1930. *Esquema detallado de una cúpula tabicada genérica de Guastavino.* Fuente: Sweet's Catalog, 1931

4 Conclusions

Guastavino understood that they were not the styles what highlighted his work, but the reliability of the integral control of the process. He managed to impress customers, to convey his impulse, improving the system and expressing efficiently the benefits of his achievements. The timbrel vault seduces not only because it involves a lower quantity of construction materials, but because it is built in the air, defying gravity. It is his greatest contribution. Rafael does not dominate the calculation methods, but try to fit them gradually, controlling errors. He did not pursue decorative design by itself, although his vaults become a hallmark, capable of transmitting at the same time exclusivity, reliability and lightness.

The drawings we show are not pretentious, they do not intended to be anything but the description of a continued progress. This produces an interesting analogy between the Guastavino's works and the tiles that make part of them. Bricks and tiles, considered individually, are modest and limited, but putting together their small individual contributions they can transform themselves into surprisingly slim constructions, almost weightless.

Guastavino's images are very eloquent at that point. As a constructive detail, the solution is clear, sincere and open. The construction technique is shown, confident in the protection granted by the laws of intellectual property in the United States. He pursues and manages to convey corporate reliability, constructive transparency, and finally remarkable consistency in the evolution of his thinking. Drawings in this article may be used to illustrate a treatise on construction, or as a base for calculation, layout, etc. as well as advertisements. But above all they show the progress being introduced experimentally and then consolidated quickly and firmly in technical and technological improvements.

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Vernacular Architecture Drawings: A Recognition for Modernisation of Spanish Architecture

Pedro Miguel Jiménez Vicario, Manuel Alejandro Ródenas López and Amanda Cirera Tortosa

Abstract This paper focuses on the study of vernacular architecture's drawings made by the 1925s Generation members during their education period at the Madrid School of Architecture. This study will let us analyse some graphic aspects (emphasis, represented elements, type of graphics, etc.) showing the interest of that group of teachers and students. They tried to defend popular architecture's drawing as one way to modernize Spanish architecture and as a compromise with the architectonical reality of the country. In addition, they could reveal an unsuitable educative system according to the needs and artistic trends of that moment.

Keywords Sketch · Vernacular architecture · Education

1 Introduction

During the first two decades of twentieth century, the Spanish architectonical reality was marked by the coexistence of a large variety of trends. On the one hand eclecticism and historicism, on the other hand, the modernism and the opening of uncertain ways trying to reach an own tradition based on "national styles" that were swinging between the manifests of traditionalism and regionalism. Mountain architecture, Basque, Catalan, 'neoplateresco', 'neomudejar', Madrid-born baroque, 'postherreriano', were architectures born from the tradition of searching a "Spanish way of being". This way was interpreted either as a mimetic reproduction of the past or an adaptation of external ways to national idiosyncrasy (Laborda 2008). At

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the same time, the external was considered all that dealt with Wien Sezession, Berlage, etc., and it was being introduced progressively into the Spanish architectonical reality.

In this varied context, there were several critical voices in many Spanish cultural spheres that pronounced against a past oriented architecture that, in some occasions turned into "kitsch" architecture. For instance, Torres Balbás (1918), in the *Arquitectura* magazine, felt very sorry about the prevailing general confusion and claimed the popular classes tradition against fashion, trends and clichés.

According to Navascués (1993), the central stage of Spanish popular architecture could be established between the Seventh National Architecture Congress held in Seville in 1917, where the title of the fourth communication was "Intervención del Arquitecto en la Arquitectura rural y medios para conseguir en ella un fin artístico", and the welcome lecture in the San Fernando Fine Arts Academy given by Teodoro de Anasagasti and titled *La arquitectura popular* (1929).

About the first event, it should be pointed the lecture held by Lampérez with the title *Antecedentes históricos de la arquitectura rural en España*. From that moment, Torres Balbás began to study, together with Fernández Balbuena, Anasagasti and Zuazo, vernacular architecture, claiming the concept of tradition against formal debate. In addition, such concept was understood from the perspective of materials study or its constructive standardisation, human and urban scales, organic settings, environmental relationships, and its application to the country reality that was being introduced into events and magazines. This concept derived from German Werkbund.

The references to the vernacular studies became especially remarkable in the 1920s decade through the lectures of Lampérez and Romea (Boletín 1922a) in the Madrid Ateneo titled *Arquitectura rústica y popular*, Gustavo Fernández Balbuena (Boletín 1922) titled *La arquitectura humilde de un pueblo del páramo leonés* and Pedro Muguruza (Boletín 1922) with his lecture about the Basque house. The studies on the popular Basque house were compiled in various publications such as *Anuarios de la Sociedad de Eusko-Folcklore* from 1925 to 1928 by Barandiaran Ayerbe, J. M. and the works by Baeschlin (1930) (Fig. 1).

There were other publications more generalist such as the journal by Elton (1928: 4) in *La Gaceta Literaria* or the Exhibition celebrated in 1926 about "Ciudad y vivienda moderna" where there was a specific section dedicated to regional architecture.

2 The Work of Torres Balbás and Teodoro de Anasagasti at the Madrid Architecture School

Carlos Flores (1989) sets 1925 as a deadline between the last trends confusion and the recently graduated students of Madrid Architecture School, in need of renovation. That generation of young architects was called "generation of 1925" and

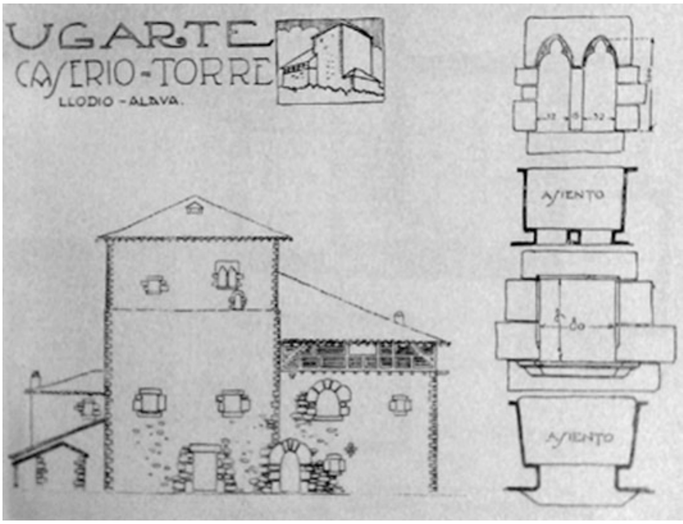


Fig. 1 Baeschlin, A., Hamlet drawing, Llodio (Baeschlin 1930, 41–43)

included Blanco Soler and Bergamín that ended their studies in 1918, Casto Fernández-Shaw and Miguel de los Santos Nicolás that ended in 1919, Agustín Aguirre, Sánchez Arcas y Regino Borobio, José Azpiroz y Muñoz Catasús in 1920, Lacasa y García Mercadal in 1921, Carlos Arniches, Martín Domínguez y Durán Reynals in 1922, Gutiérrez Soto[1] in 1923, etc. Even though the boost of Spanish modern architecture had definitely begun, all the previous trends—regionalism, historicism, etc.—coexisted during the 1920's decade and lasted until the arrival of Spanish Civil War.

The Architecture School was the faithful reflection of the architectonical reality of the country. For instance, Luis Lacasa (Diéguez Patao 1997, 19) expounded "that was a chaotic education period, messy, eclectic in all senses. We looked down on our teachers. Our true school was the Library".

Mercadal answered the question about who had boosted the rationalism in Spain with the sentence: "It was the librarian Inchausti who introduced the rationalism in Spain, we did not know anything, he brought to his library the first German books that showed us the new architecture." (Laborda 2008, 14). In this context, Teodoro de Anasagasti and Torres Balbás developed their own approaches referring to the training of Architecture Schools as an integration between tradition and modernity. Together with Antonio Flórez Urdapilleta and César Cort, they began the change in the architectonical sensitivity in the 1920's decade, although their professional careers swung between the eclecticism and orthodox rationalism arrived from Europe.

[1]See Diéguez Patao (1997).

Teodoro de Anasagasti was professor of Projects at Madrid School of Architecture and a studious defender of vernacular architecture. During his trips around Europe, he could know the degree programmes of other European schools, such as Munich and Wien, and about that matter he wrote in the magazine *'Arquitectura y Construcción'* (1914). He dedicated an analysis in the work *'Enseñanza de la Arquitectura'* (1923), where he outlined the revision of the studies program of 1914,[2] considered a very theoretical program and a bit far from the professional scope.

Anasagasti proposed the travel as an indispensable part of the students training. The trips should "teach them how to research, to make each one of them discover their own truth" (Anasagasti [1923] 1995, 110) with the teacher's attitude to let the students perceive and draw with free incitements. Such incitements could derive either from monumental architecture either popular architecture and, even though he does not refer exactly to the drawing of vernacular,[3] he does illustrate the text with own sketches of popular architectures from Granada and Spoleto in 1910.

The references to vernacular architecture appear again in the Tivoli sketch (Fig. 2) in his censoring of copy-drawing and when narrating his memories in the Polytecnicum of Munich.

First of all he wanted the drawing to be done outside the classrooms: "Let us dispel the beginners from the sad and corrupt atmosphere of the classrooms, from the enervating and mechanical work, from all that ruins their spirits. Let us lead them where life and career are shown, and let them feel joy because they have found something fascinating" (Anasagasti [1923] 1995, 206).

The drawings should be born from "the desire of tracing hectically a few lines" as he shows in his sketches of Basque or Asturian popular architecture and some popular houses from the bank of the Danube in Wien, drawings in movement, as the teacher indicated, made from the car (Fig. 3).

More explicit referring to popular architecture he was in his welcome lecture at San Fernando Fine Arts Royal Academy just six years after publishing *Enseñanza de la Arquitectura* in 1929. In his speech he established that "the picturesque, distinctive and personal, the purely Spanish" could attract "foreign scholars". He identified popular architecture hidden in rural environment as a national genuine product, where intelligence, adaptation and genius were shown and considered it was gradually disappearing facing a modernity with its new materials and "anodyne shapes" (Anasagasti 1929, 11).

His text constitutes a whole allegation to popular architecture as an art's object, as well as a folk exaltation appreciating the benefits of the new materials and techniques. He conferred the artistic value that other architects had already done

[2]The study program of 1914 continued until 1933. In 1931 and 1934 the magazine AC criticized the Architecture Schools. These were considered to be unaware of the social and constructive changes of that age. They criticized them for developing an "academic" teaching in order to re-establish the historic styles.

[3]The only explicit reference to popular architecture drawing is written in the "travel sketch" section where he mentions the landscape drawing, the skyline of the villages, rural buildings, etc.

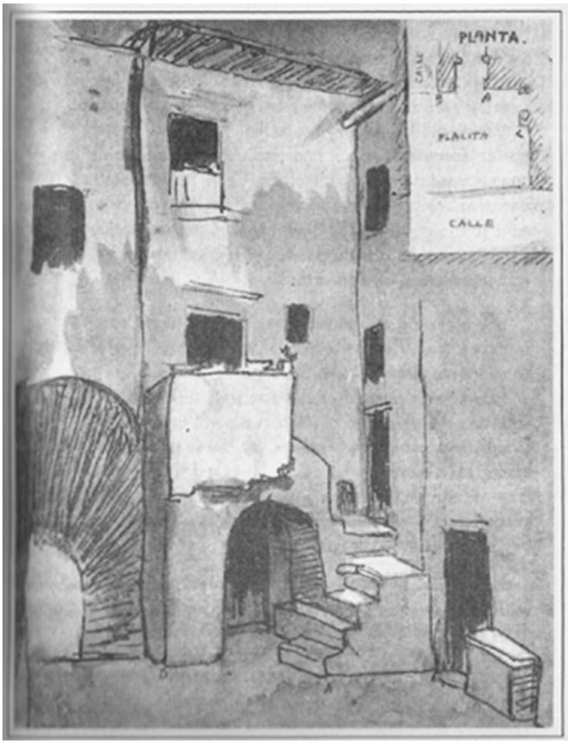


Fig. 2 Teodoro de Anasagasti, drawing of vernacular architecture, Tivoli (Anasagasti [1923] 1995, 197)

Fig. 3 Teodoro de Anasagasti, drawing of vernacular architecture from passenger car, Asturias (Anasagasti [1923] 1995, 225)

before him. Thus, some of the members of the 1998-generation established that "the conservation and study of popular architecture, in all its multiple manifestations is a substantial matter in the artistic history in Spain" (Anasagasti 1929, 21).

His brand new ideas for the study program of the Architecture School were in common with Torres Balbás (1923, 37) who defended the study of tradition and history as a source of knowledge and a base for planning:

"If the architect does not know the tradition, if the architect ignores the history of his art, then he will fatally assume the shapes for his creations from the existing buildings of the surroundings (…) Let us take advantage of our predecessors experience moving freely within the tradition".

As Anasagasti did, Torres Balbás passed the interest for popular architecture on their students and he left proof of it throughout a series of journals published in the *Arquitectura* magazine. That is the case of "Utopías y divagaciones. Hacia la ciudad futura" (1920) and "Glosas a un Álbum de dibujos" (1922) in which he compiled the work of Mercadal and Rivas Eulate *Documentos para un estudio de la arquitectura rural de España* (Fig. 4) with drawings of houses from Castile, Aragon, Asturias, Basque Country, Navarre and Extremadura, exhibited in the Fine Arts National Exposition.

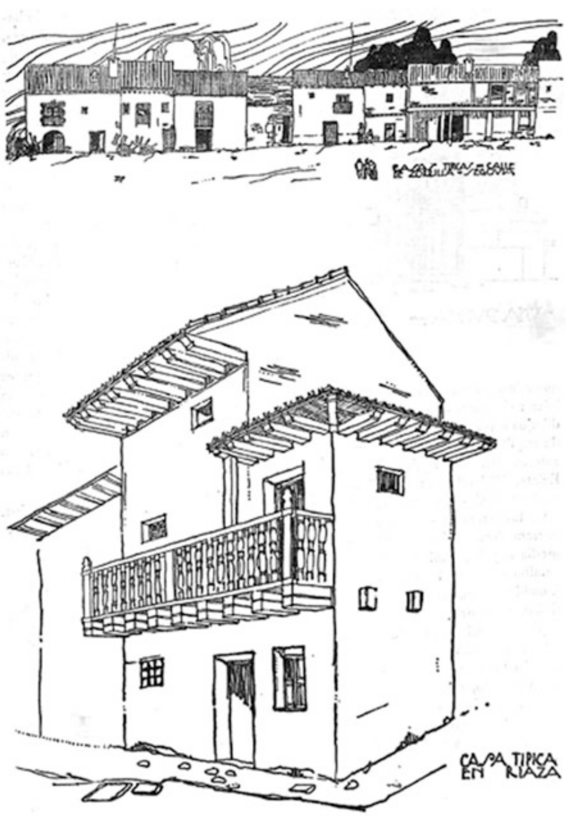


Fig. 4 García Mercadal and Rivas Eulate, drawing of a street in Zorrilla and dwelling in Riaza (Torres Balbás 1922, 341)

About this work Torres Balbás (1922, 348), wrote: "The sketch album by García Mercadal and Rivas Eulate, notes the right trend of many of these young architects that begin to work in their careers. Years ago, it had not been found anyone who traversed Spain copying the humble works of popular art (…) Nowadays the young architects, avid for seeing and knowing, go across Europe, comparing our architecture with the other countries, acquiring a wider and precise concept of it".

Some of their contributions were published periodically from 1919 in the section "Unknown hideouts of the ancient Spanish architecture" in which he showed drawings and photographs of ancient Spanish architecture made by him during his travels. In this sense, at the beginning of the 1920's decade his activity was intense, giving the lecture in the Ateneo about "Mountain houses" and in 1923 took part in the competition promoted by the Madrid Ateneo with a memory titled "Popular architecture in several regions of Spain".

He censored, at a time, the claim character of the work of Le Corbusier for his intransigence and dogmatism in his work, being one of the first references to Le Corbusier in Spain (Torres Balbás 1923a). The text about popular architecture would be later used by his student García Mercadal in his work *La casa popular en España* and also published in the work *Folklore y Costumbres de España* directed by F. Carreras i Candi.

3 The Architects of 1925 Generation

As a consequence of the education received at the Madrid School of Architecture by Anasagasti and Torres Balbás, architects such as Mercadal, Fernández-Shaw, Sánchez Arcas, Bergamín or Lacasa concerned about popular architecture in the 1920s considering it as an acceptable element for the architectonical renovation that could place Spanish architecture between the eclecticism of the past and the new sensitivity coming from Europe.

Even though there are several authors that establish that the assumption of modern movement was formal and stylistic rather than into deeper matters—Sambricio, Pozo, V. Astorga, etc.—, it is fair to recognize the important impediment constituted by the academicism of the past and the difficulties that clashed with in order to evolve toward rationalistic stances coming from Europe. In addition, the position of the architects of 1925 generation opposite popular architecture indicates a priority that go further of purely formal matters and deal with logic and constructive honesty in a more sensitive context for the reality of the country.

Most of them pronounce themselves in *La Gaceta Literaria* (1928) about the role of regional architectures[4] in the "architecture to come", coinciding, with different touches though, in the positive role that such architecture should perform.[5]

The dualism vernacular-modern can be analysed in Casto Fernández Shaw, who baptised the magazine that he founded from 1930 to 1936 and from 1944 to 1963 with the significant name *Cortijos y Rascacielos (Cottages and Skyscrapers)* (Fig. 5). Its topic swung between the technologic praise and native tradition, and its purpose was to make a "modern magazine that could involve both general and technical public (…). Cortijos y Rascacielos will cover from Spanish rural architecture, of the white and horizontal patch, to the blacken verticality of the work warren" (Cortijos and Rascacielos 1930, 1).

José Borobio was an architect that tried to continue with the task started during his training stage at Madrid School of Architecture referring to trip and drawing of popular architecture: So did he make a variety of drawing of anonymous architectures, six albums between 1928 and 1936, because for him, its simple and functional shapes were comparably to the modern architecture theories (Fig. 6).

It should be also underlined, referring to regional and popular architecture, the work of other architects such as Pedro Muguruza, whose drawings we have already related to, Luis Feduchi and Carlos Flores, as well as the drawings and photographs of Lucien Briet, Adolfo Mas Ginesta, Ricardo Compairé Escartín, Julio Soler Santaló, Fritz Kruger and José Ortiz-Echagüe (Fig. 7).

The case of García Mercadal is specially significant because of the important labour he started in order to promote modern architecture in Spain and above all, because the special attention he paid for the Mediterranean vernacular architecture. Following the advice of Teodoro de Anasagasti who encouraged him to follow his way, Mercadal won the Prize of Rome in 1923, joining up the Academy that same year and beginning his works about the Mediterranean house. From his first year in Rome, he was concerned about two main facts: the architecture that was being made in Europe and the vernacular architecture from the Mediterranean.

During his first year of stay in Rome, Mercadal started out his research about Mediterranean popular architecture: he visited the popular architecture of the Gulf of Naples, the Amalfi coast and Sicily in his trip of 1924. There he did a great number of sketches that were useful to make new releases in watercolour, ink or gouache and that were exhibited in Rome in 1925. He used those drawings for illustrate the journal *Sobre el Mediterráneo, sus litorales, pueblos, culturas. (Imágenes y recuerdos),* title of his welcome speech in the San Fernando Academy in 1980 (Fig. 8).

[4]Due to the possible interpretations available of the term "regionalism", we shall analyse the answers taking into account two possible meanings, "regional architecture" as it is, or "vernacular architecture".

[5]See Jiménez Vicario (2015).

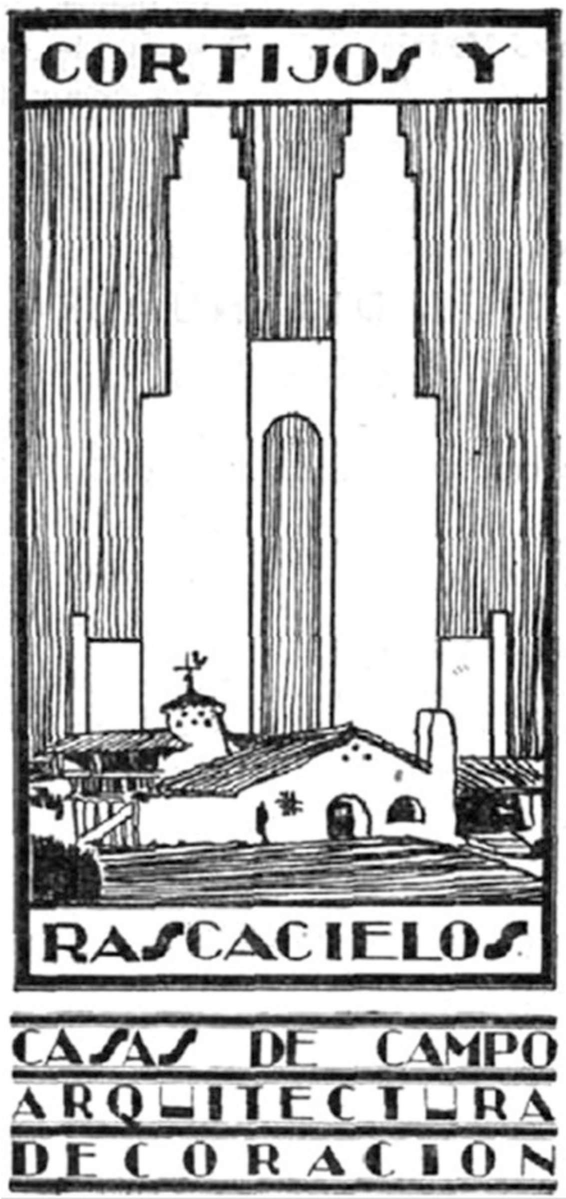


Fig. 5 Drawing for the cover of the magazine *Cortijos y Rascacielos*, 1930 (Cortijos y Rascacielos 1930, 1)

With this approach, Mercadal (1984, 16) attributed to the founders of modern movement the one and only achievement of knowing how to read the architecture that resided in the Mediterranean many centuries ago, and all the values related to it, in a moment in which the economical and social conditions required it: "Some of the features of this Mediterranean architecture such as simplicity of forms,

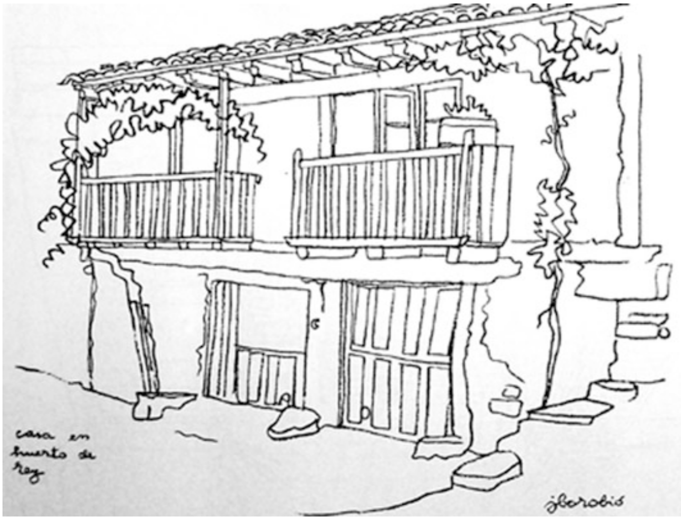
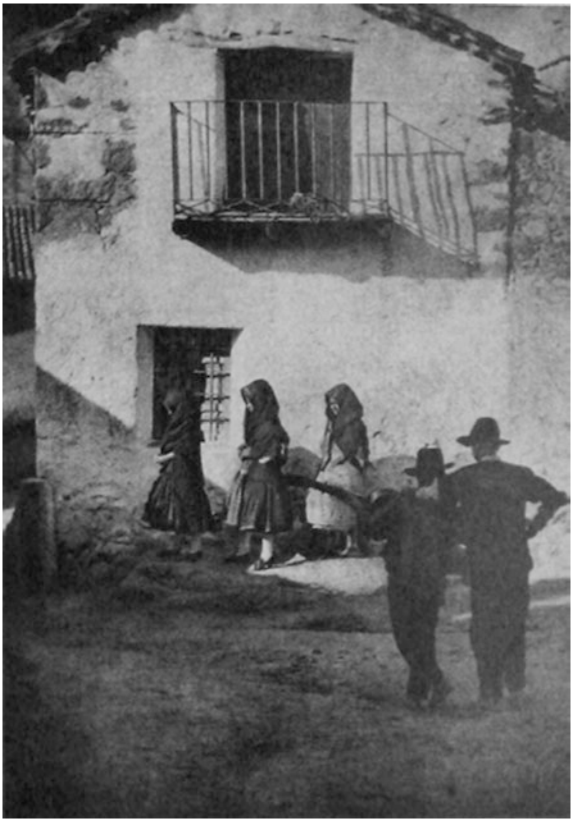


Fig. 6 Borobio, J., sketch of vernacular architecture, Huerta de Rey, 1934 (Vázquez Astorga 1999, 386)

Fig. 7 Ortiz Echagüe, J., street in Lagartera, 1920–1923 (Museo Nacional de Antropología y Carretero 2002, 195)



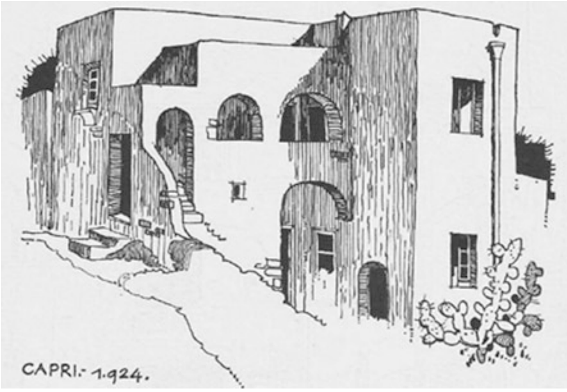


Fig. 8 García Mercadal, F., sketch of vernacular architecture, Capri, 1924 (García Mercadal 1996, 38)

decoration absence, cubism, colour intervention, his terraces (…) coincide absolutely with those of the most advanced architecture, more fashioned today in the European nations, in France, Germany, Denmark, Czechoslovakia, Austria, etc. (…) and it would be also interesting to research about the possible influence of these Mediterranean buildings on the founders of this trend".

From this perspective, Mercadal felt he had full legitimacy to propose a Mediterranean modern architecture as he did in his two journals titled "Mediterranean Architecture". Instead of using own drawings or photographs of the Mediterranean vernacular architecture to illustrate them, he chose to present drawings and models of his own projects, such as a house in Sicily and a house in the seashore in the first part of the journal (Fig. 9).

4 The Drawings by Le Corbusier on Spanish Popular Architecture

García Mercadal was the main contact with the European vanguard and to a large extent the responsible of the lectures of Le Corbusier (1928), Mendelsohn (1929), Theo van Doesburg (1929–1930), Gropius (1927–1938) and Luytens at the Students Residence of Madrid. The visit of Le Corbusier in 1928 reinforced the Mediterranean root of his work and the superiority of the Latin world opposite the northern, in a moment of frustration and crisis after his failure in the competition for the United Nations Palace. It coincided with the generations of architects leaded by Mercadal in Madrid and J. Ll. Sert in Barcelone and the later travel on board the Patris II ship from Marseille to Athens in the celebration of the fourth CIAM.

As Martín Domínguez (1971, 35) declares, attendee to the lecture in Madrid, Le Corbusier talked to them surprised for the many aspects he considered a contribution of the architectonical modern glossary such as "plain pure shapes", "the whiteness of whitened walls" and voids that drill them decisively. He had had the

UN «CHALET» EN SICILIA.
Arquitecto: García Mercadal.

ARQUITECTURA MEDITERRANEA (1)

El fenómeno geográfico ligado a nuestra vida es la habitación, que es tan efímera como la vida misma, y que si bien desaparece y se renueva con gran rapidez, presenta, por otra parte, una cierta permanencia, tanto en sus caracteres generales como en sus formas — en cierta medida éstas dependientes del ambiente —, de las condiciones naturales del suelo, variando, sin embargo, poco la estructura fundamental de la casa, por responder a pocas formas de economía agraria.

Entre todas, la casa rural, la verdaderamente popular, aquella que en sus orígenes es construída por un solo hombre, es la que expresa más claramente los caracteres de dependencia frente a frente del cuadro geográfico, constituyendo un precioso documento de la historia.

Existen lugares, como en algunos del mundo mediterráneo, donde esta dependencia de la casa al suelo es tan grande, tan íntima la compenetración con el paisaje, que se diría inseparable del mismo: la casa aquí es tan del paisaje como los árboles o los montes, la casa es como una vegetación natural.

Esta maravillosa compenetración de la Arquitectura con la Naturaleza, sólo la encontramos conseguida en las construcciones rurales, tan al margen de los cánones escolásticos, y constituye por eso mismo una de las mayores dificultades que tiene que vencer el arquitecto de hoy, eminentemente escolástico, cuando

(1) Notas de un estudio en preparación sobre «La casa mediterránea».

Fig. 9 García Mercadal, F., project of detached house, Sicilia, 1926 (García Mercadal 1926, 192)

opportunity to see all these from the train in the village of Castile in his way to Madrid. After the conference in Madrid, Le Corbusier moved to Barcelona where he had been called by Sert.

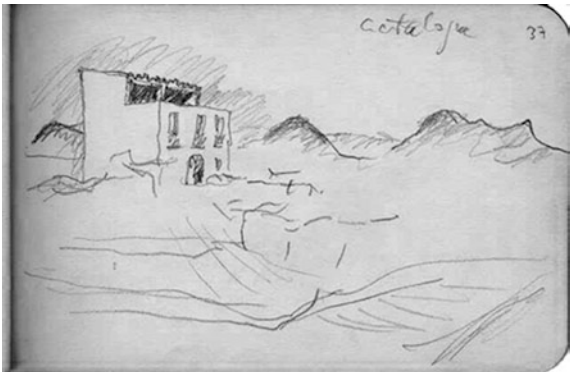


Fig. 10 Le Corbusier, sketch of vernacular architecture, Cataluña, 1928 (Imagen W1-694-001 from notebook of trip C-11, Fondation Le Corbusier)

During his stay in Sitges, Le Corbusier[6] could write "a) houses of total pureness, plastic event of world class, organic event of world class = tradition's houses = from the selection = from the purification = from the standard. B) Very at one side, the recent cadavers learnt at schools" (Fig. 10).

The experience of Le Corbusier in Madrid and Barcelona helped to define that "Mediterranean awakening" to provide Latin world architecture a greater presence opposite the northern architecture. The impression that our country made in Le Corbusier remained in the carnet drawings of may 1928 where vernacular architecture scenes, landscape, people and many other aspects of the rural scope appear. In this way, he reinforced the attitude of the 1925 generation members as well as their teachers Torres Balbás and Teodoro Anasagasti, and he showed the way to the group of Catalan architects leaded by Josep Lluis Sert who understood that a 'tradition-born' modern architecture was possible.

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The Figure of the Architect-Teacher in the Second Half of the 18th Century in Valencia

Consuelo Vidal García, Marina Sender Contell, Marta Pérez de los Cobos Cassinello and Pablo Navarro Esteve

Abstract The topic of the paper is to analyze the figure of the architect as a teacher in Valencia in the second half of the eighteenth century. We'll start studying the "Real Academia de Bellas Artes de San Carlos" in Valencia and its connections with the "Academia de San Fernando" in Madrid, to delve the research about the architect's teaching inside academy, focusing on academic training, requirements to the graduates, demands, and on the competence allocations at this time, emphasizing the figure of Antonio Gilabert, author of the most important works in Valencia during this period.

Keyword Architect · Valencia · Academy

Fine Arts Academies in Spain focused on training in theory and practice for artists as individuals and as a collective. For architecture, these institutions were particularly significant because the variety of related professions were structured precisely on the basis of the training and competences acquired. From the outset, the academies insisted on meditated study of art reference sources and contemporary publications, with particular emphasis on ones from abroad because that approach permitted a distinction between enlightened intellectual academic activity and the profession. Professional activity was singled out as lacking any theoretical training and was only recognised as an artisan activity. In addition, academic activity wanted to be

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recognised for its universal language, governed by immutable rules and endowed with indisputable historic importance, in the form of classicism. Thus the academic artist distinguished himself from the professional artist who, following the Baroque tradition of previous decades, provided solutions rich in ornamentation at a much higher economic cost. The academic artist therefore, would contribute not only a theoretical and enlightened component to his work but also an economic one.[1]

In 1753, the Academia de Bellas Artes de Santa Bárbara was founded in Valencia, gathering a collective of mainly sculptors, artists and *retablistas* (altarpiece artists) with the intention of endowing the arts with a cultured and enlightened approach. A sea of tensions soon emerged between two coeval opposing worlds. On the one hand, the world of the enlightened and cultured, many from the military world of the first half of the 18th Century, with a rationalist, functional way of thinking. On the other, the world of artists, sculptors and *retablistas* trained in the Baroque style, linked to architectural adornment and disassociated from mathematics and theory. Architects were severely displeased by the incursion of sculptors and painters into architecture and many considered it to be the cause of a decline in architecture. The academic basis of Santa Bárbara was drawing as the centre of all the arts, deeply rooted in the profession. Professional architects were excluded from teaching architecture, which was the job of artists and sculptors trained in the study of the orders of architecture and perspective.

When it began, the Santa Bárbara Academy was not attached to the San Fernando Academy in Madrid (founded the year before), but it cites the Madrid Academy in its founding documents as an example to follow. Three years later, the academy in Madrid established the dependency of all academies created in Spain, but given the way it operated, the Santa Barbara Academy ignored the instructions and, unlike the Madrid academy, maintained artists and sculptors as teachers of architecture. Perhaps as a result of this attitude, after various attempts by the Academy to request royal protection, it did not achieve the state subsidy it needed and so in 1761 it stopped teaching and after various attempts to survive, it finally disappeared (Berchez 1987a, b).

In the same year, shortly after the Santa Barbara Academy disappeared, a group of artists, including Ignacio Vergara and Luis Domingo and later, Vicente Gascó and Felipe Rubio from Valencia, applied to the San Fernando Academy for the degree of Academician of Merit. Once granted, Vicente Gascó, Master Builder of the Royal Palace in Valencia, and Felipe Rubio presented the San Fernando Academy with a document requesting the creation of an academy in Valencia. The projects that Gascó presented to obtain the degree showed the influence of antiquity, as his sources were the treatises by Vitruvius, Alberti and Palladio. Gascó's insistence on theoretical training is relevant for understanding the trend in architecture at the threshold of Spanish neoclassicism (where treatises from classical

[1]That is how José Enrique García Melero (1997) presents the role of the San Fernando Academy in Madrid, and of the academic artist in the academy. This description can be generalised to all the Spanish academies, taking the Madrid academy as reference.

antiquity and the Renaissance were of decisive importance) and his desire to break with Baroque tradition in Valencia. All these ideas reflected in the projects Gascó presented to the San Fernando Academy were very well received.

Felipe Rubio, architect of the Customs House in Valencia, was from a previous generation and was soon to die and so Gascó was responsible for bringing a critical, enlightened and rejuvenating attitude to the new San Carlos Academy in Valencia.

In 1765, a Preparatory Board was set up to create the San Carlos Academy. Vicente Gascó and Felipe Rubio were appointed directors of Architectural Studies. The Real Academia de Bellas Artes de San Carlos was founded in 1768. After that and until 1846 it was authorised to issue degrees in architecture, provide instruction and from 1790, it controlled public architecture in the area of Valencia through the Committee for Architecture. After that period, its responsibilities were reduced and it became simply a Preparatory School for Architecture and Master Builder studies.

1 Byelaws. Exams, Qualifications

The founders were not given a free hand in the drafting of the byelaws but were subject to the San Fernando Academy, although it is evident that the Valencia academy had a more comprehensive determination to influence in the architectural medium. Right from the start, the Academy intended to be an instrument for reforming the arts (Berchez 1987a, b).

The byelaws set out the examinations for obtaining qualifications in architecture and they changed throughout the period when the Academy was authorised to award degrees according to the changes made in San Fernando in Madrid and the Royal provisions that affected them. Three periods can be differentiated:

2 1768–1786

The byelaws drafted in 1768 reflected the 1757 arrangements at the San Fernando Academy (Berchez 1981). The articles do not mention the qualification of Architect, but, in the chapter *Prohibiciones* (Prohibitions) all tribunals, judges, ministers and guilds are forbidden to award qualifications to practise architecture and they establish a “rigorous examination” for anyone who does want to practice, involving “not only the theory of Architecture, but also the practice of Geometry, Arithmetic, Machinery and other sciences, mathematics…” (Bérchez and Corell 1981, XIX). Anyone who did not pass the examinations would be awarded a qualification with restricted powers. The byelaws called candidates to sit for an examination at the Academy within six months counting from the date the byelaws were published. Those who passed the exam were authorised to value, measure, direct and design construction work and those who did not were told what conditions they should abide by according to their ability and what control they should accept. This was the embryo of the future qualifications of architect and master builder.

During this period, which lasted 18 years, 37 qualifications as architect were awarded. Most of the projects presented for examination from the stylistic point of view kept the decorative elements characteristic of the local Baroque style combined with certain classical elements. They correspond to a period when the Academy found it hard to introduce classical criteria.

3 1786–1802

In 1786, the entrance examinations for architects of merit and those for the practice of architecture were reformed (Berchez 1981). In the first examination candidates had to make the design for a building chosen by the Academy in a room at the school without being seen by the professors. They had to present plans, sections and elevations. When the design was finished, they were examined to ensure that the candidate was actually the author. The second part consisted in an examination on their knowledge of construction systems concerning stonework, carpentry and everything related to stereotomy as well as knowledge of geometry and calculus necessary for the profession. Certification of attendance at works directed by well-known architects was also required. It was also possible to qualify as an architect by entering the General Competitions, open to the public in general and usually held every year. In this case, candidates were exempt from the first examination (Figs. 1, 2 and 3).

During this period, which lasted 16 years, 17 qualifications in architecture were awarded. From the formal point of view, these projects showed a strong trend towards classicism. Coinciding with moments of severe economic shocks, ornamental details were simplified, enveloping the buildings in sobriety (Figs. 4, 5 and 6)

4 1802–1846

In 1802, a Royal Order was published establishing the requirements for a qualification in architecture (Berchez 1981):

1. “Prueba de pensado”. Plan of a building invented by the candidate, with floor plans, elevations and sections. A report had to be added to the plan with the construction method and detailed calculation of the cost of the building, designed for construction in a place imagined by the author. The Committee for Architecture assessed the design and if the result was favourable the candidate would go through to the second examination.
2. “Prueba de repente”. A report had to be presented together with a certificate showing that the candidate had followed a work directed by a qualified architect.

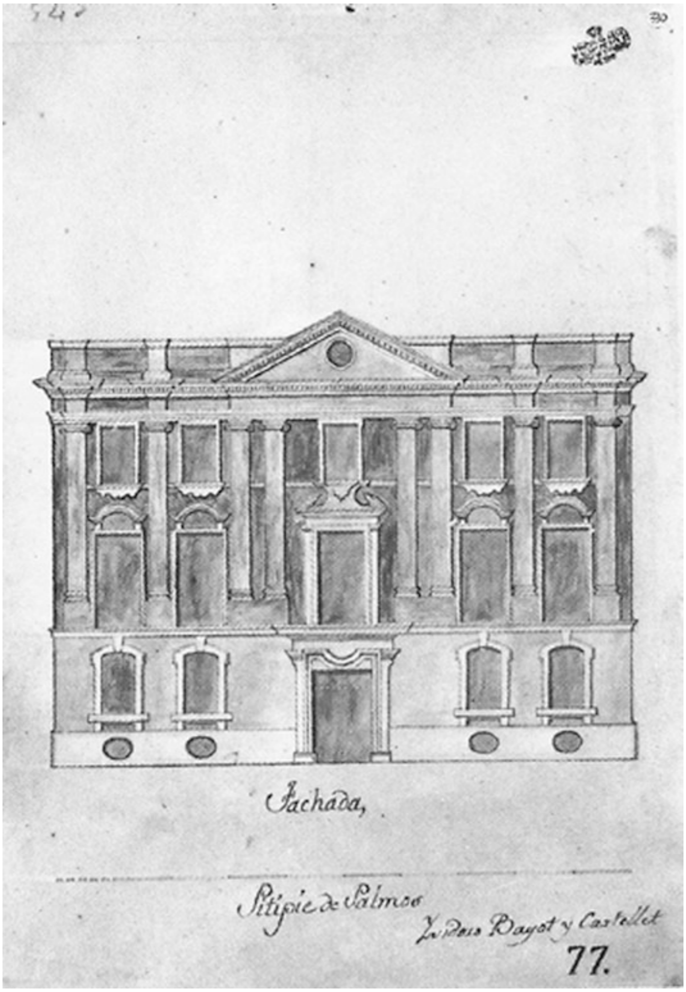

Fig. 1 Design for a private home, by Isidoro Bayot y Castellets. 1772. (Bérchez 1981)

To carry out the sudden examination the Academy had to have a book or file which included the subjects that could be chosen. The Vice-protector of the Academy would extract three numbers at random and the candidate would choose one of them. The candidate would remain isolated in a room in the Academy for 15 h from 7 in the morning until 10 at night. During that time he could consult all the books on architecture that he wanted to.

3. When the professors had reviewed the two works, the candidate had to undergo an examination in which he was asked about the two works and about matters concerning the theory and practice of architecture. The board of examiners

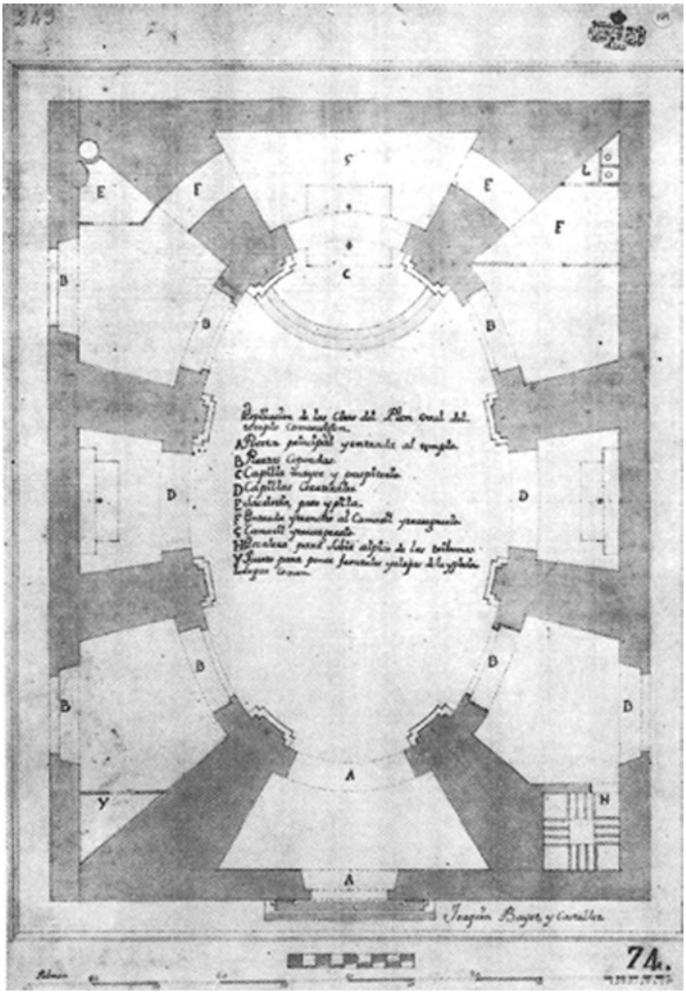

Fig. 2 Design for an oval chapel of 80 and 50 spans, by Joaquín Bayot and Casteblet. 1772. Floorplan. (Bérchez 1981)

notified the Ordinary Meeting of the candidate's pass or fail and the Meeting had the final decision on whether or not to grant the qualification in architecture.

The qualification that the Academy gave after this latest remodelling is that of Master Architect and it included all the powers of building, science and trade, including in a single qualification the competences of designing, directing, building, measuring and valuing both private and public works. This new qualification valued practical knowledge but distanced itself from professional activity based on pure practice. Much importance was attached to the project, but it had be accompanied

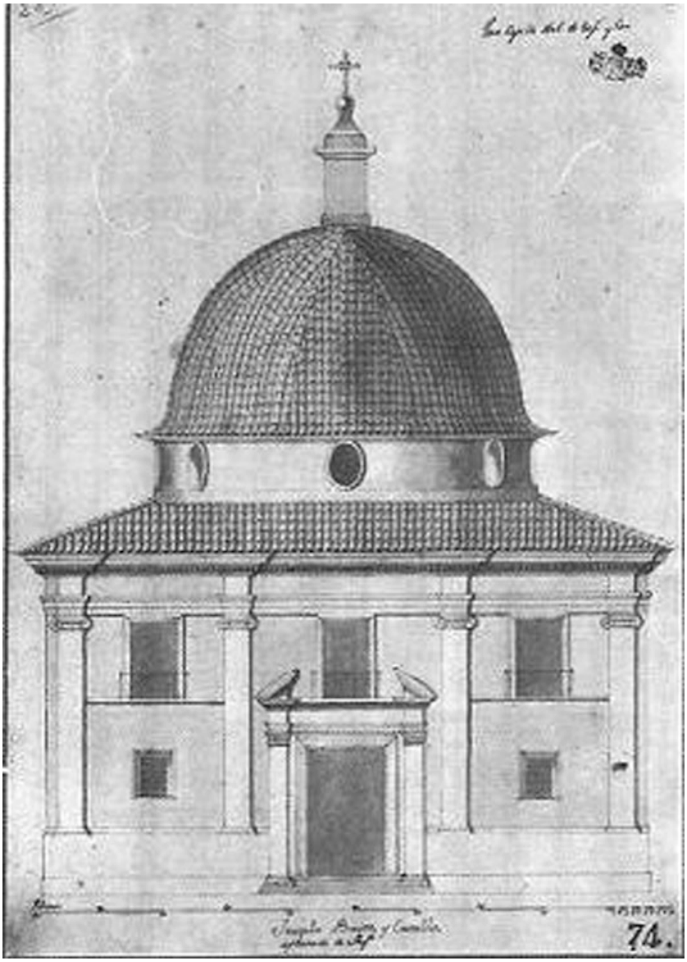

Fig. 3 Design for an oval chapel of 80 and 50 spans, by Joaquín Bayot and Casteblet. 1772. Main façade. (Bérchez 1981)

by a report on the construction method and calculation of the cost thereby acknowledging the practical facet of the work.

In this period, between 1802 and 1846, the Academy awarded 47 qualifications in architecture. The projects presented for the purpose are valuable documents because they show the architectural ideals of the Academy at that time, which correspond to Valencian neoclassicism. The Academy's repertoire was inspired by Roman and Greek antiquity within a marked historicism. The most studied treatises

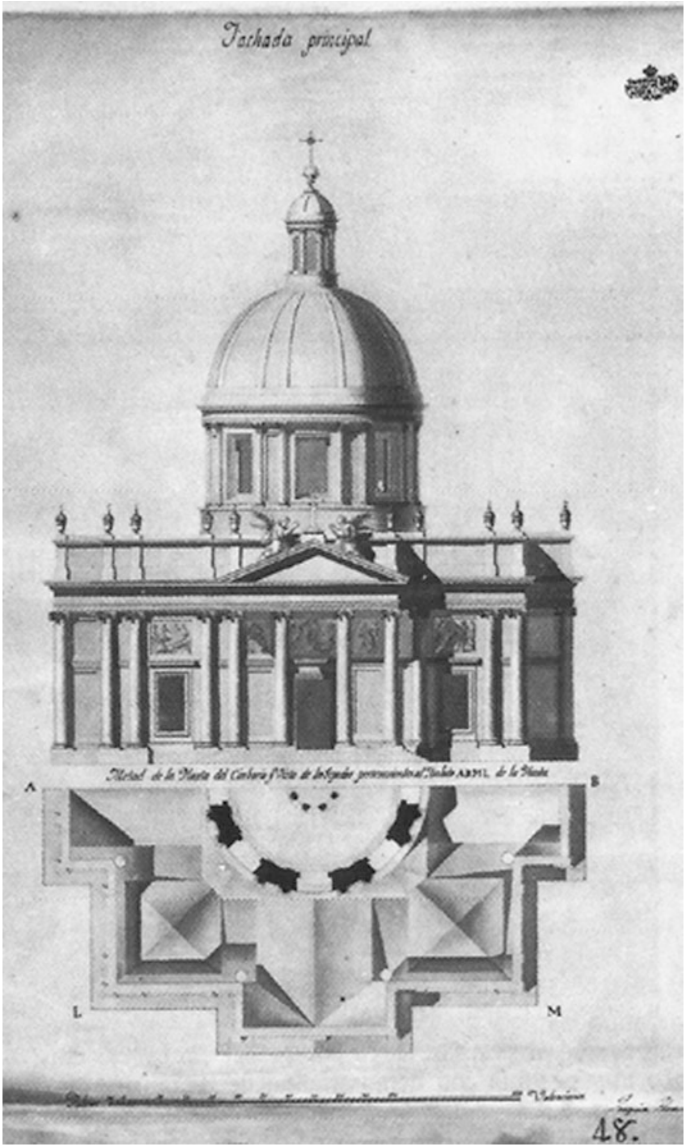

Fig. 4 Design for *"Capilla Hermita de nueba planta dedicada á Maria Santisima bajo el título de la Purisima Concepcion en las cercanias de una ciudad"*, by Joaquín Tomás y Sanz. 1795. Main façade. (Bérchez 1981, 140)

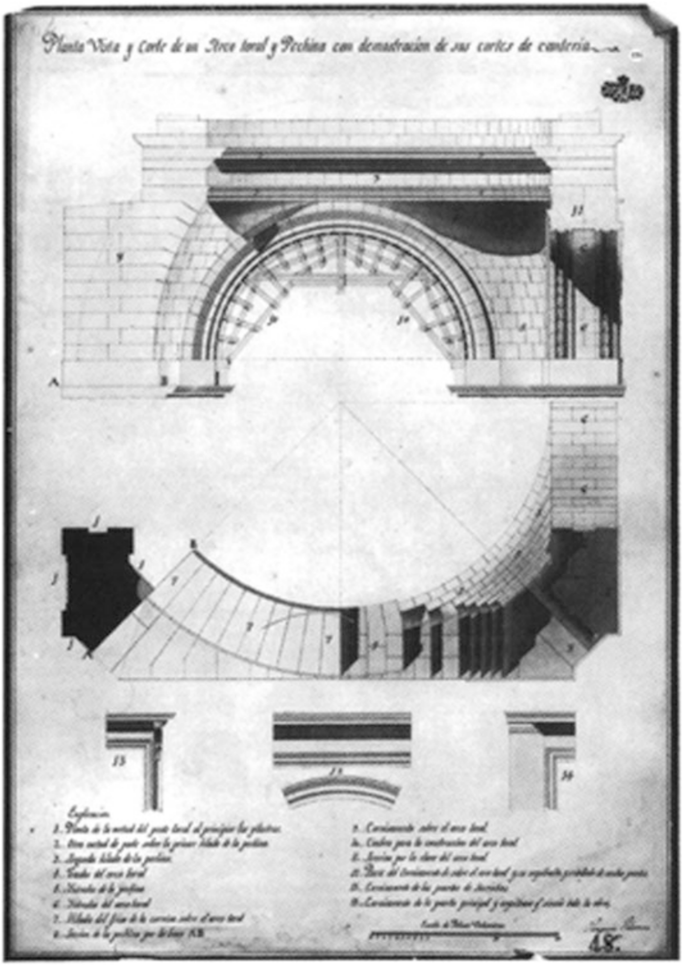

Fig. 5 Floor plans, elevations and sections of a toral arch and pendentive showing the stonework cuts for the project *"Yglesia en forma de cruz griega dedicada á la Resurreccion del Señor",* by Josef Ariño. 1797. (Bérchez 1981, 142)

were those by Vitruvius and Palladio. The professors of architecture also exerted significant influence through their own projects (Figs. 7, 8, 9 and 10).

"Prueba de pensado": Project for *"Baños publicos en lo interior de una Ciudad",* by Antonio Sancho. 1833. (Bérchez 1981, 213):

"Prueba de repente": *"Fachada de una Carcel de Corte"*, by Antonio Sancho. (Bérchez 1981, 213):

With these provisions the practice of architecture was linked to the architect and disconnected from the activities of the trade. In addition, the intention was to put an

Fig. 6 Design for *"Yglesia Catedral"*, by Salvador Escrig. 1797. Main façade and longitudinal section (Bérchez 1981)

end to the excessive protagonism of artists, sculptors and *retablistas* which particularly affected the design of doors, altarpieces and fountains. The development of the learned, theoretical and technical nature of the teaching was supported by the *novator* movement in Valencia which, from the first half of the 18th Century, fought for the application of the study of physics and mathematics to architecture. This is where the great Valencian debate originated and the Academy played such an important part in its mission to support this modern enlightened nature in contrast to the mentality of the Baroque culture, which had such strong roots in Valencia. The nature of these byelaws caused conflict among the professionals affected by the prohibitions both inside and outside the Academy. In this regard, the creation in 1790 of the Committee for Architecture was immensely helpful, making it obligatory to present all projects for works built in the territory of Valencia to the Academy for approval or rejection, and thus providing legal backing to deal with the issues raised.

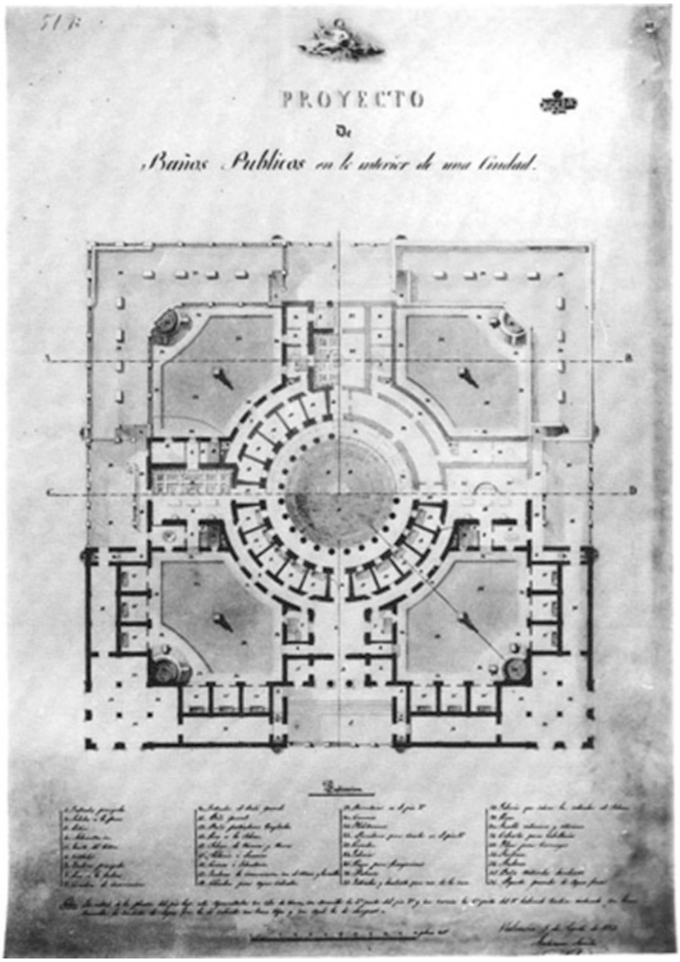

Fig. 7 Floor plan for the ground, second and third floor

5 Courses

The byelaws indicated that the directors and professors of the Academy must follow San Fernando's *curso de arquitectura* (Berchez 1987a, b). This course is the one which, in 1757, professors Ventura Rodríguez, Diego de Villanueva, Alejandro González Velázquez and José Castañeda had been commissioned to write with the recommendation that it should be a compilation of the best treatises in the Academy's library. From 1762, Diego de Villanueva and José Castañeda took charge of writing the course. Castañeda was responsible for geometry and arithmetic and Villanueva for a treatise outlining the orders of architecture as part of a broader syllabus for architecture studies. These first two works, structured and

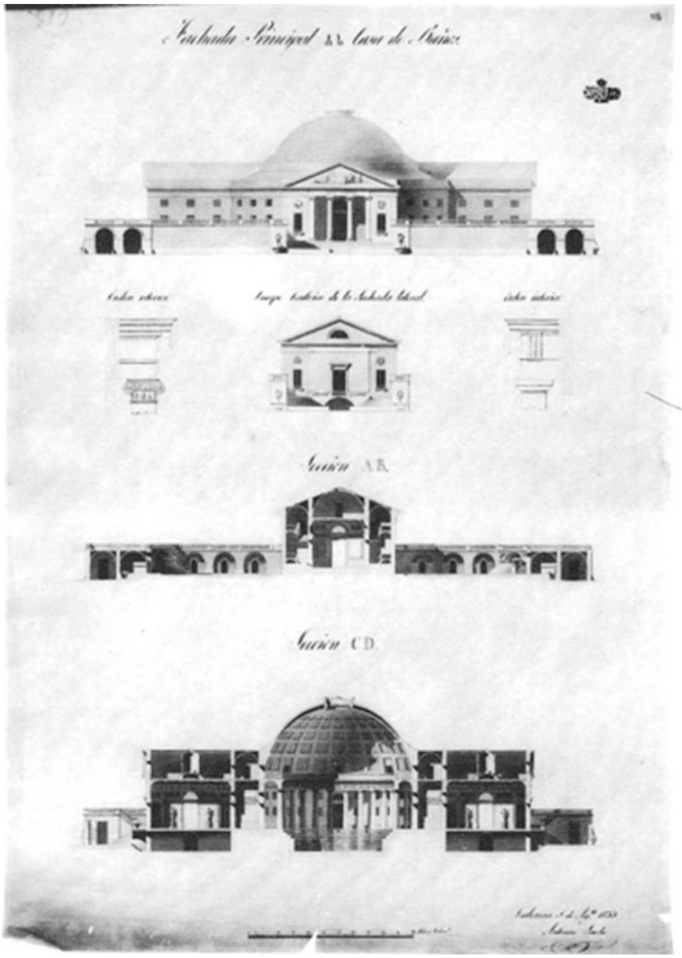

Fig. 8 Main façade, central body of the side façade, two transversal sections and details

elaborated between 1764 and 1765, were well received at the academy in Valencia. Hence Vicente Gascó asked for a copy of them in 1766 before they were approved at San Fernando. Curiously, these works were not only not approved, they were harshly criticised and in 1768 the order came for them to be destroyed, although their prints were already circulating round the San Carlos Academy. On the issue of the subjects that should be taught in architecture studies, the byelaws only specified the principles of drawing, geometry and arithmetic adapted to architecture, and the theory and practice of architecture. Neither of the two academies developed a more elaborate syllabus. That was justified on the basis of the elaboration of the aforementioned *curso de arquitectura*.

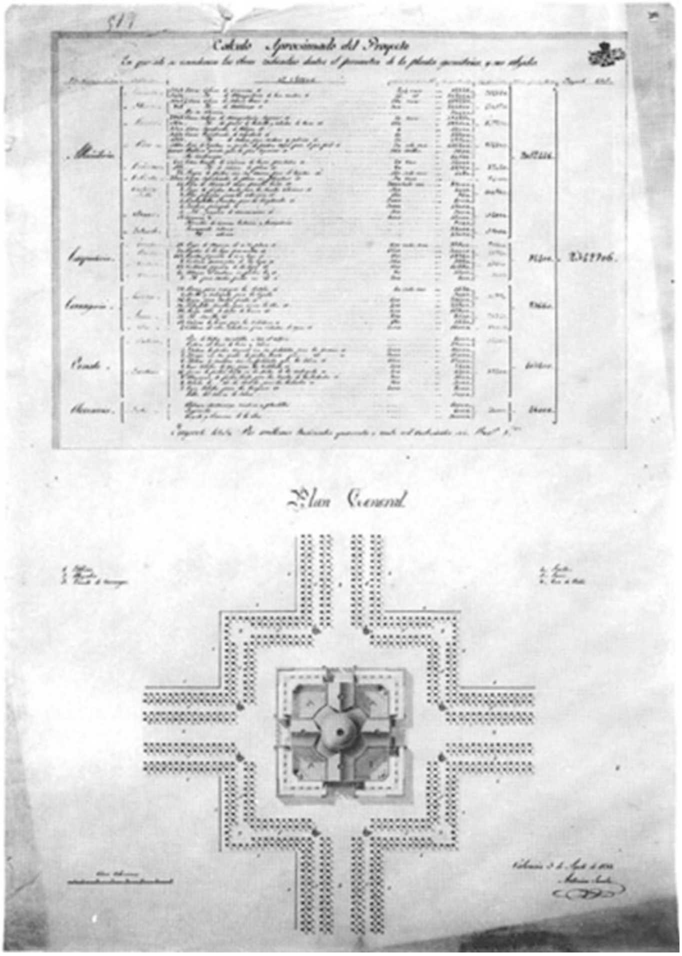

Fig. 9 Project: Site plan and approximate calculation for the project

6 The Library

The composition of the Academy's library collection is important for understanding the academic trend (Berchez 1987a, b).

The first two books Vicente Gascó asked to purchase were *Les ruines de Palmyre, autrement dite Tedmor au désert* (1753) and the aforementioned *Curso de Arquitectura.* The former was also a reference book at the San Fernando Academy. Gascó requested this book in an attempt to establish "good taste in architecture" (Bérchez 1987, 155).

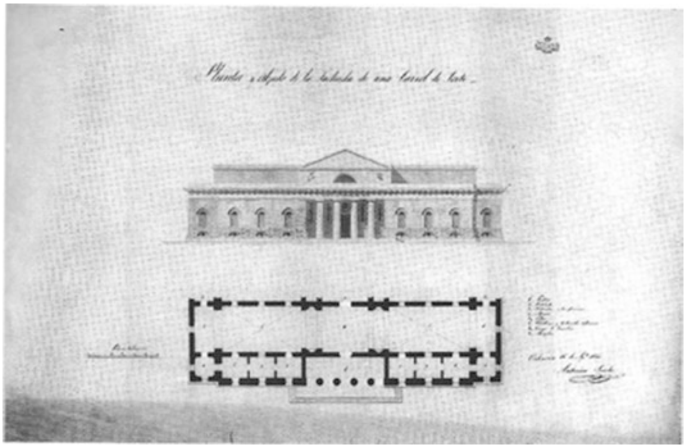

Fig. 10 Floor plan and elevation of the façade

Secondly, by 1765 on the occasion of the foundation of the San Carlos Academy, the San Fernando Academy presented the Valencian academy with the main classical treatises, Vitruvius, Palladio, Serlio and Vignola. The Academy's aim was to build its library from classicism, as though starting from zero.

The Vitruvius treatise was the Latin and Italian edition by Berardo Galiani, published in Naples in 1758.

Los cinco órdenes *de la arquitectura* by Vignola, published by Roma in 1732.

The work by Palladio was a version entitled *Architettura de Andrea Palladio Vicentino di nuovo ristampata, e di Figure in Rame diligentemente intagliate arricchita, corretta, e accreisciuta di moltissime Fabbriche inedite; con le osservazioni del Architetto N.N.,* by Francesco Muttoni, in Venice between 1740 and 1761. This great work was not exclusively about Palladio but also included aspects of the treatises by Vitruvius, Vignola, Serlio and Scarmorzi. In volume IV it included plates of the most emblematic Venetian churches by Palladio. The fact that Palladio's treatise did not include plates of his churches it gives an idea of the importance given to the diffusion of Palladian churches in the Academy. This book awoke much interest among the architects at the Academy because of the existence of a theoretical body critical of the Baroque and because of the assimilation of classical rules that filled the void left by the repudiated Baroque. It became a great work tool at the academy in Valencia.

Another important book that the San Fernando Academy presented to the Valencia Academy was the treatise by Serlio *Architettura di Sabastian Serlio Bolognese, in sei libri divisa,* Venice 1663, on Geometry, Architecture and Perspective.

In addition, two books on perspective were purchased by the Academy: *Le due regole della prospettiva practica de Giacomo Barozzi da Vignola* (Roma, 1664), by Egnacio Danti, and *La pratica de la prospettiva di Monsignor* (Venecia, 1568), by Daniele Barbaro.

A book affiliated to the Roman baroque trend was also purchased, *Modelo de la chiesa di San Filippo per la P.P. dell'Oratorio di Torino, inventato e disegnato dall' Abate, e Cavaliere D. Filippo Ivvara* (Turín, 1758), by G. Baroni di Tavigliano, and plates by Piranesi.

7 Antonio Gilabert, Teniente de Arquitectura

In 1766, Antonio Gilabert Fornés (1716–1792) was appointed lieutenant of architecture. He was brotherin-law to Felipe Rubio, director of architecture together with Vicente Gascó. Before entering the Academy, Gilabert worked as surveyor in the construction of the Customs House with Felipe Rubio, around 1758. There is not much information about his work before that time, but taking into account that when he entered the Academy he was already fifty years old, we can assume he had experience and a style of working in the Valencian environment by the second half of the century. Gilabert must have been infl by the architectural environment of the first half of the 18th century (from the same generation as Ignacio Vergara), particularly Father Tosca's mathematics, and the local classical language represented in the church of Saint Thomas in Valencia (Berchez 1987a, b). This is the spirit refl in works during the Academy's early years and Gilabert is a clear exponent of this period of transition in the Academy and of the assimilation of the new classical concepts by a professional in the local environment. His attitude in the Academy was always one of support for Vicente Gascó against the abuse of its regulations governing professional practice, although in this regard his intervention was not as active as that of the director.

In 1768, he was appointed director of architecture together with Vicente Gascó because Felipe Rubio had died the year before. It can be said that Vicente Gascó and Antonio Gilabert dominated the architectural and academic scene in Valencia in the last third of the century but Gilabert's personality and a curious sensitivity in adapting classical postulates to local taste meant that he understood his clients much better than Gascó. Thus Gilabert became an architect who bridged architectural tradition in Valencia and the Academy's classical approach and he played a major role in the local environment, compared to Gascó who was considered more radical.

In fact, he built one of the most significant works in the Academy's initial period (Berchez 1987a, b). In the city of Valencia he finished the Church of the Pious Schools and the remodelling of the Cathedral from 1774.

The combination of the different personalities of the two directors of the Valencia Academy provided it with a balance during agitated times of great change. Vicente Gascó represented the iron conviction of the classical trend and injected the theories and treatises of antiquity and the Renaissance into the training of architects.

Antonio Gilabert, however, very pragmatically, managed to gradually introduce that language and conception of architecture to the general public while also attempting to satisfy (with the occasional liberty) the wishes of his promoters. It was not always easy, firstly, the entities that commissioned the works were used to ornament and the traditional decorative Baroque taste in Valencia and so they were reluctant; and secondly, and more importantly, the trades working in architecture were strongly opposed, because artists, sculptors and *retablistas* could see their scope of work being reduced. They had no alternative but to adapt, because this situation was not just a local trend. The influences arriving from Italy and France corroborated the fact that this "new" or "ancient" language had come to stay and the Napoleonic invasions of the early 19th Century provided the proof.

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Decor and Graphic Trace in Ceramics from Tradition to Contemporaneity

Anna Marotta

Abstract In the contribution is assumed that, within the larger Visual Culture, the Drawing (especially considering the graphics trace as signifier) is a strong character in the formal language. If this is true always, of particular interest appears the role of the "tracer mean" in the decoration of ceramic, support that may enhance the expressive characteristics inherent in visual project: by the immediate spontaneity of the manual sign, freely conducted (e.g. in decorations landscapes and figures) up to the rigor of geometric patterns, also realized through stencil and "masks". Another goal of this paper is to probe the relationship between expressive and technical aspects and contained meanings. Without excluding the essential cultural matrices in the training of artisans and artists, viewed in a first reference historical-critical context.

Keywords Visual project · Drawing · Graphic trace · Decoration · Ceramic

1 Introduction/State of Art

All over the world, in the history of art, craft and architecture, ceramics (including porcelain, majolica, pottery) had the widest circulation, with gradually different functions and meanings. Beyond the different realization techniques, manufacturing and production, particularly complex is the field of decorations (even architectural), with specific interest in visual and graphic. Regarding decorative patterns, we can see typological repertoires of other decorative elements: geometric (as the Viennese ceramics of Eighteenth and Nineteenth century), naturalistic (flora and fauna) and the "figures" or landscapes one.

Considering the period between the Sixteenth century and the present day, in a huge repertoire, we can therefore mention many original schools and "factories",

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with their artists, artisans (“arcanists”) and entrepreneurs: Castelli, Faenza, Deruta (with the Sixteenth century “ballads”, typical bowls for sugar almonds) in Albisola and Savona in Liguria (famous the big hydrias pharmacy, with *anguiformi* handles, by Guidobono), Cafaggiolo (known for dishes with artworks of famous painters reproduced with great expertise, mythological and biblical scenes, in dark blue broad brushstrokes, yellow and pale almost translucent green); from Vienna to Capodimonte, even in its Nineteenth century developments with Giustiniani, Mollica, Battaglia, Mosca. Without forgetting the essential and fundamental contribution of France (Sevres, Limoges), England, China, Japan. A particularly good example is in the architectural and urban applications as in the Arabic and Islamic reality and the related contamination in the *mudejar* style, without forgetting, for example, the Spanish-Portuguese Azulejos (joints afterwards in Latin America) and Caltagirone in Sicily (with the famous staircase).

Getting to the point: is it possible to get to some sort of virtual “iconographic repertoire” of decorative types, a first “mental model”, before coming to analyze the graphic project of the decoration? And what kind of training was required to the “hand painting” artisans? Was it purely practical, or theoretical concepts were also provided? And in the current academies and art schools, how can it combined traditional methods and current digital technologies? And will it be possible to promote craft training also in schools?

Although uneven and not deepened, a first chronological-descriptive feature imposes, taken from a critical selection made by analogy or dissimilarity.

2 Italian Examples from Sixteenth Century Onward: Technique, Art, Meanings

A first spark (especially on the implementation and tracing of the graphic decoration) was provided by a particularly appropriate figure for the contribution about this subject: it is Cipriano Piccolpasso (Casteldurante, 1524–1579) architect, historian, ceramist and Italian majolica painter, especially remembered as treatiser. From a Bolognese aristocratic family settled in Casteldurante (currently Urbania), an important center for ceramics production, he received a good humanistic and scientific education. After being an architect of fortifications in Central Italy (Ancona, Fano, Perugia and Spoleto) he came back to his native city, where he founded a famous majolica factory. His treatise of three books, published for the first time in Rome in 1857–58, is fundamental for the history of ceramic art and the techniques in Italy during that time. From his work, (*I Tre libri dell’arte del vasajo: nei quali si tratta non solo la pratica, ma brevemente tutti i secreti di essa cosa che persino al di d’oggi e stata sempre tenuta nascosta, del cav. Cipriano Piccolpasso Durantino*) see the paragraph *Muodo di far penelli*: « It must be known that paint brushes can be made by two type of hair: the goat’s one and the donkey’s one. This is when, after getting it wet and folding it with a finger, if it stays folded it is not

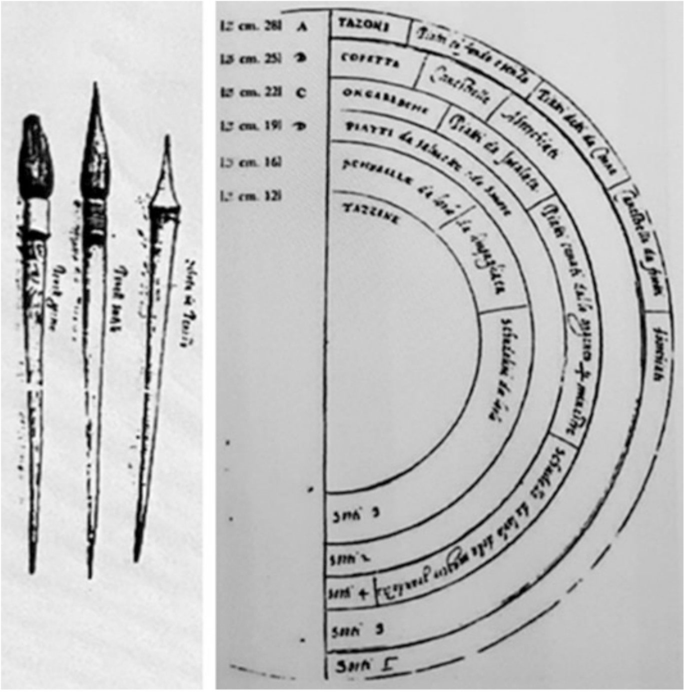

Fig. 1 Essential elements in Drawing and graphics on ceramics: types of brushes for ceramics decorations: *penello grosso*, *penello sutile*, *setola di penello*. Proportional scheme of various ceramic objects diameters. In Cipriano Piccolpasso, *I Tre libri dell'arte del vasajo* (…), half of the Fifteenth Century

good, but if it comes back straight in his state, then it is good. Many people, in order to make thin paint brushes, to paint stained, usually mix some rat hairs, those around the muzzle » (Fig. 1) (see Bartolomei 1988, Leonardi1981, Piccolpasso 1879).

As an evidence of the quality achieved by the artisans (artists) of this field, we can remember some Sixteenth century examples. Among the ceremonial dishes, see the one (Fig. 2b), with Christ risen from the Tomb, Fontana's workshop, Urbino (1570–1580): characterized by a great and complex decoration, apparently due to the higher activity of the famous workshop of Urbino: it can be seen, for comparison, both the samples now at the Herzog Anton Ulrich-Museum in Braunschweig (Lessmann 1979, 362–425), and the various examples of this production recently published by Ravanelli Guidotti (2006), *ad vocem*. Similar in workmanship and *ductus* is the centerpiece compote of polychrome majolica (Fig. 2a), Guido da Merlino's workshop, Urbino, around 1540–1545 (Melegati 2015). The bowl illustrates the myth of the bull that Phalaris, tyrant of Agrigento, commissioned to Perillo by Athens, as a sophisticated instrument of death: made of brass to contain those condemned to death.

Fig. 2 **a** Centerpiece compote of polychrome majolica, by Guido da Merlino's workshop, Urbino, around 1540–1545. Decorated with Perillo's story; h 6 cm, ∅ 26.2 cm. **b** Plate of polychrome majolica, probably by Fontana's workshop, Urbino, 1570–1580. Decorated with Christ risen from the tomb; h 4.2 cm, ∅ 27 cm. **c** Centerpiece compote of polychrome majolica, Deruta, Eighteenth century. With heraldic decoration and *grottesche*; h 6.8 cm, ∅ 26 cm. **d** Parade plate of polychrome ceramic, Neapolitan manufacture, second half of the Nineteenth century. Decorated with stained frame *'a grottesche'* and with a central figure depicting a pastoral scene. The monogram on the back 'A.D.'; h 4 cm, ∅ 45 cm

Once it burned the beast transmuted the moans of the victims in the bellows. According to the legend, in the end both the inventor and the tyrant will be forced to test the effectiveness of the invention. The myth met a large spread in that time. To also notice the famous engraving mark by Pierre Woeiriot (1532–1596?), dated before 1562 and derived from Baldassarre Peruzzi: here it is treated by an active painter of the important Guido da Merlino's workshop in Urbino. For a recent analysis of the activity of this furnace, and the famous painters working there, see also Timothy Wilson (Wilson 1996, 266 *passim*).

(a) (b)

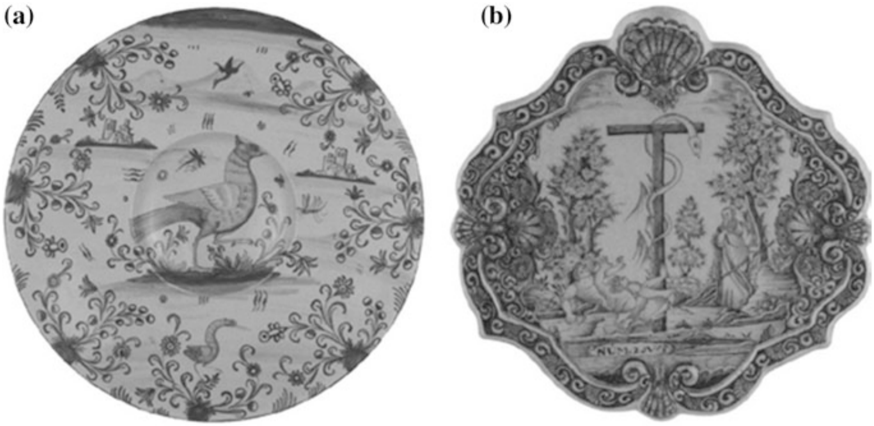

Fig. 3 **a** Plate of *white* and *blue* majolica, Pavia manufacturing, Eighteenth century. With decoration in landscapes; h 5.5 cm, ∅ 47 cm. **b** Two-color majolica plate, furnace of Delft, Eighteenth century. With a mixed-linear and relief frame, decorated with an Old Testament scene ("The bronze serpent"); h 34.5 cm, l 35 cm

To compare, for analogy and/or differences, see: plate of white and blue majolica, *"a Berettino"* with decorative landscapes, Pavia manufacturing, Eighteenth Century (Fig. 3a); or plaque of two-tone majolica, furnace of Delft, Eighteenth Century (Fig. 3b), framed and mixed-line relief, decorated with an Old Testament scene ("The bronze serpent") (see Ballardini 1933–1938;Bertini 2012, Burzacchini, Emiliani,Morganti 2015; Caruso 2006; Conti 1973;Lessmann 1979; Liverani 1958; Melegati2015; Rackham 1940; Ragona 1991;Salamon 1968; Sanguinetti 2015; Wilson1996).

Frequently used were also the so-called *"albarelli"*, some examples in Fig. 4a, like the one of blue and white majolica, furnace of Caltagirone, (early Sixteenth century), decorated in monochrome cobalt blue with a geometric decoration in three bands with ogival motifs formed by circles and semicircles (Melegati 2015). Similar to a sample published (in Governale 1986, n. 282, 198), Fig. 4b. The *albarello* in white and blue majolica by Trapani or Naples furnace, (mid Sixteenth century), decorated with a "large knots" motif. In addition to the shared assignment of materials of this type to Naples, we remember that G. Russo-Perez expressed his favor to the Sicilian furnaces (1954). the Fig. 4c shows a *cilindrone* of polychrome majolica, by Andrea Pantaleo (Palermo 1613), decorated with figures of St. John the Evangelist in a medallion with ribbed frame on a "trophies" fund and the socalled "Frederick's chain". A very similar item with figure of Saint Peter in a medallion made of identical drawing and painting, is in the Sicilia National Gallery. The high quality and the presence of the Senate initials and the similar date insert it in the best Palermo production (Antonino Aragon 1975, n. 55, 38). Another similar great sample, showing a figure of a holy monk, is exposed in the majolica museum *Duca di Martina* at *Villa Floridiana* in Naples, an important Lazzaro's workshop

Fig. 4 **a** *Albarello* of *white* and *blue* majolica, furnace of Caltagirone, first half of the Sixteenth century. Decorated with cobalt blue monochrome with three bands of geometric ornamental design with ogival motifs made by circles and semicircles; h 29 cm., 14 cm l. **b** *Albarello* of *white* and *blue* majolica, Furnace of Trapani or Naples, half of the Sixteenth century. Decorated with motif "in large knots", with few flaws and small deficiencies of matter and enamel; h 29,50 cm, ∅ 13 cm. **c** *Cilindrone* of polychrome majolica, Andrea Pantaleo, Palermo, 1613. Decorated with figures of St. John the Evangelist in a medallion with ribbed frame on a "trophies" fund and so-called "Frederick's chain", shows the mark "SPQP" and the date "1613"; h 36 cm., 25 cm l. **d** *Cilindrone* of polychrome majolica, Lo Nobile's workshop, Caltagirone, last quarter of the Eighteenth century. Decorated with floral "Venetian" pattern; h 34.2 cm, l 20 cm

production (Arbace 1996, 60–61). Both are considered artwork by Andrea Pantaleo, (A. Governale 1986, 148–149, 102). The presence, in the chalice decoration, of the same cross-shaped rosettes supports this hypothesis, as the result of the fitting working relationship between Pantaleo and Lazzaro's workshop in Palermo.

In Fig. 4d: *Cilindrone* of polychrome majolica, Lo Nobile's workshop, Caltagirone, last quarter of the Eighteenth century. Antonino and Letterio Lo Nobile had a particularly busy workshop in the last quarter of the Eighteenth century in Caltagirone, known for the quality of its production: the "Venetian" motif often used by them becomes a very successful decorative form (A. Aragon 1991, 169 and ill. 182–190). An artwork with a very similar decorative form can be found in G. Croazzo, (R. Ausenda 2010, 94, n. 32).

But the short and not systematic review of cases here considered, privileges programmatically Nineteenth century examples in the Neapolitan environment (less cared by the critics of the field) and yet not lacking of visual sparks regarding the visual project of decoration, the technical choice of tracking, and finally the level of the executive skill. In any case, a methodological historical-critical approach is indispensable, to aim to both learn about the cultural component in the training of artisans, and the inheritance of the technical implementation. With this premise, it will remain fundamental the beginning from the historic moment tied to the Eighteenth Century *Real Fabbrica Ferdinandea di Capodimonte*.

3 From the Capodimonte Factory to the Unification of Italy: The Cultural Roots of Drawing

Without recalling the birth, and the articulated cultural objectives behind the project of Carlo di Borbone, and his fitting developments, it is plausible to assume as fundamental the contribution of Domenico Venuti, after the designation (1780) as Intendant of the same porcelain factory, who shared the artistic direction with Filippo Tagliolini and Giacomo Milani (see Donatone 1974; Fiorillo 1992;Mosca 1908; Perrotti 1990; Perrotti 1998).

The conversion of the *Manifattura Reale* in an art school is the outcome of thought, anticipating times, of Venuti. The first step in this direction was the establishment of the "*Accademia del nudo"* in which Costanzo Angelmi, director of the Academy of Fine Arts, was giving lessons about techniques and rules of drawing and molding in relation to anatomy. The quality imprinted by this type of training, was penalized for a certain period, (also in relation to national political events), and then it found new dignity. It was already noted that « While for the golden age of Neapolitan porcelain of the Eighteenth century it is possible to trace a chronological evolution following in order the stylistic and qualitative development of borbonic production, it seems, in contrast, extremely problematic to summarize events, aesthetic transformations and sources of inspiration of the Nineteenth century ceramics production (…) » . (Angela Caròla-Perrotti 1990).

Cesare Tropea recalled how the unification of Italy surprised Naples in a time of artistic crisis: the writers of the time claimed that of the applied art had remained just the technique. (Tropea C. 1941). Porcelain, by now extremely rare, is no longer used, while there is an increasing of common and ceremonial objects as well as the finishes of the contemporary architectural facades. The *"Ancient Neapolitan Art Exhibition"* (1877), with the organizing committee led by Prince Filangieri, will lead to the support of the Minister De Sanctis, to change the set of rules for the Academy of Fine Arts in Naples (by Royal Decree, 1878) and divided into two sections; the first with the schools of painting, sculpture, architecture, and the second dedicated to the teaching of design and the practical application schools. The Board of Directors of the next *Museo Artistico Industriale* (and the attached school and workshops), gave the position of Director of the Museum for purchases and legacies of ancient works to Domenico Morelli, while Filippo Palizzi had the teaching of ceramic processing.

4 Neapolitan Experiences in the Nineteenth Century: Mollica, Mosca, Battaglia

Mollica brothers' factory was opened, around 1842, by Giovanni, Pasquale Mollica's son, a former worker of the *Real Fabbrica Ferdinandea*, who later became workers' leader for Giustiniani. With Giovanni's sons, Ciro, Achille and

Alessandro, who lead the factory during the second half of the Nineteenth century, the production appears mainly addressed to an imitation of Castelli d'Abruzzo and Urbino majolica. Among the three brothers, Achille got special recognition for its painted decorations in the various Italian exhibitions of the last years of the Nineteenth century. His objects, linked to the typical trend of "Revival", surprised his contemporaries for his paintings—he had been a student at the Academy of Fine Arts—as well as for the considerable technical expertise. Since the early Twentieth century, the factory had been led by Carlo, in particular from 1927 to 1940, a period characterized by its distinctive marking with a crowned M, which connotes the beautiful majolica vase (Fig. 5). The beautiful quality of the decoration even for the execution (not easy for uneven surfaces), illustrates in a full field ("Castelli manner") Paris' judgment, with recognizable female protagonists: Aphrodite, Hera, Athena. An excellent graphic performance, with fine and accurate shapes of faces and bodies, with a clear and delicate background of the sky with light clouds, and an effective representation of the landscape, a clear legacy of the cultural impulses impressed by Venuti and De Sanctis. The mark is a blue crowned "M".

Fig. 5 Vase with *biansati* handles of polychrome majolica, Carlo Mollica's workshop, Napoli, 1927. Decorated with mythological scene representing 'Paris' judgment'. With the recognizable three female figures of Hera, Athena and Aphrodite. Signed 'M crowned'; h 81 cm, ∅ 41 cm

Mosca's factory activity, began around 1865 as Raffaele Mosca and C, and then as "Fratelli Mosca". One of Raffaele's sons, Luigi, specialized in the manufacture of enamel on gold, directs this factory, (increasing the squares for floors) inheriting by Giustiniani, and Del Vecchio, many famous specialized workers (like Tobia Strino, former painters' head of Angelantonio Paladini and later Master of the *Museo Artistico Industriale* in Naples), Antonio Mollica, brother of the more famous Giovanni conductor of his own industry whose son Achille prevailed in the last decades of the Nineteenth century. In the same factory it was invented the so-called "*smaltino*": light blue for ceramics, which allowed the Neapolitan producers of majolica to no longer depend on foreign countries for this product, it was called "*o smaltine d' 'o prevete*" because it was sold by one of the brothers that was a seminarian at that time. Around 1872, Giuseppe went to direct the mill founded by Delange that in 1880 "obtained a privilege because he found a decoration relief to be applied to the pavement and the architectural coatings" while Luigi's company exported to Northern Italy, to Spain, to London, to Paris, to Zurich and even to Melbourne in Australia. But especially to Algeria and Tunisia: the "characteristics" Arabic majolica that are still typical of the architecture and urban environments in Tunisia were largely produced by Luigi Mosca. In 1880, Delange's son created together with the architect Calcagno a company called "*Ceramica Architettonica e Artistica*". Because of the war between France and Prussia ceased orders for Delange and the company risked crisis. Left this manufacture, Giuseppe Mosca, passed to the direction of the "*Industria Ceramica Napoletana*". Luigi created an ingenious bathroom fixture stove, with a rocker valve that opened and shut avoiding bad smells (in vulgate "*cesso Mosca*", Angela Caròla-Perrotti 1990) considered at the time so revolutionary to obtain numerous awards and a gold medal of the *Istituto d'incoraggiamento*. The factory also favored the production of the ceramic not only for aesthetic purposes, but also to make houses more practical. Giuseppe came back to work with his brother Luigi, who died in 1893 and left his share to Giuseppe's son who graduated in Engineering with a thesis on the Neapolitan ceramics industries, awarded by the *Reale Istituto d'incoraggiamento.*

Less documented, but of considerable interest is the work of the ceramicist Raffaele Battaglia (S. Giovanni in Teduccio, Naples) in Mosca's factories: his vases and objects are at the *Museo delle Ceramiche Ciacchi* in Pesaro. As the remarkable example here (Fig. 6): amphora with *biansati* and *anguiformi* handles in polychrome majolica, (third quarter of the Nineteenth century). Decorated with military scene of mythological context. The rider in the foreground shows a rampant lion in the shield. This majolica was made in Naples (by Battaglia), and is documented in the collections of the *Musei Civili* of Pesaro thanks to the legacy of Marchesa Vittoria Toschi Mosca that in Campania capital held contacts with the native town of her grandmother, Princess Beatrice Imperiali. All items are most likely attributable to Gaetano Battaglia by Raffaele Mosca & C.'s manufacturing and were made between 1850 and 1885.

Fig. 6 Amphora with *biansati anguiformi* handles of polychrome majolica, Neapolitan manufacturing, third quarter of the Nineteenth century. Decorated with military scene of mythological context. The rider in the foreground shows a rampant lion in the shield. Signed G. B. (Gaetano Battaglia—Raffaele Mosca's workshop); h 95 cm, ∅ 67 cm

The synthetic review considerated here, cannot overlook some significant expressions as *los azulejos* in the Hispanic culture and the decorations in the Islamic one: the first case mentioned here is in Figs. 7, 8: *Fábrica de Cerâmica da Viúva Lamego* in Lisbon (1865), with the decoration of the facade with polychrome majolica, characterized by an exotic taste, '*a chinoiserie'*, as the frame of four human figures on the ground floor and four vases on the first floor (see Font Y Guma 1905; Gentili 2000;Gonzales Marti 1952; Maeri 1952; Olivié and CasteBrancoPereira 1994; Santos-Simoes1990).

The second example here is in Fig. 9a, b relates to the geometric decorations 'star', similar to the construction of the "*floron alicatado*" in the cloister of the monastery of Poblet in Spain, (as reported by M. Gonsales Marti 1952); and in conclusion c, d two-dimensional images with decorations based on the geometry of the circle, inspired by those in golden chalk of the al-Aqsa mosque in Jerusalem (see Ballardini 1917; Fehevari1995), realized by Osama Mansour (2014).

Fig. 7 *Fábrica de Cerâmica da Viúva Lamego* in Lisbon, 1865. Largo do Intendente, Lisbon. The decoration of the facade of the Fábrica, with polychrome majolica, is characterized by an exotic taste setup placed in frame of four human figures on the ground floor and four vases on the first floor. In the pediment there are two little angels holding a band with the year of execution of the decoration

5 Conclusions

To answer to the initial questions, we believe possible and useful to get to a virtual "iconographic repertoire" about decorative types, as the first "mental model", to arrive (through critical selections carefully evaluated in terms of the method) to the analysis of graphic design in decoration. It is essential to reconstruct in detail the type of training provided and asked to the craftsmen of "hand painting": the confirmation here emerged that it was not just purely practical, but also based on theoretical concepts, it is the proof of how close were the bonds with ancient, deep

Fig. 8 Details of the architectural decorations with polychrome majolica of the *Fábrica de Cerâmica da Viúva Lamego Lisbon*, 1865. The exuberant decoration of the factory's facade in Largo do Intendente reproduces, among others, two '*a chinoserie*' figures, holding scrolls with the commemorative inscription « Fabrica de loica de Antonio do Costa Lamego/fundada em 1849»

and varied cultural roots. This renews the interest about contemporary academies and schools of art, to be more aware of the way in which traditional methods and current digital technologies can combine. Valuing craft training in schools, will definitely be an enhancement of a cultural and technical heritage, of which present and future generations could only benefit.

Even in the ceramic, therefore, the graphic trace is configured—between signifier and signified, technique and art—as a formal complex language in the Visual Culture (for more information see: Ausenda2010; Baggioli 1999; Biancalana 2009;Furnival 1904; Giacomotti 1974; Governale1986; Meurer 1885; Ragona 1975; Russo-Perez1954).

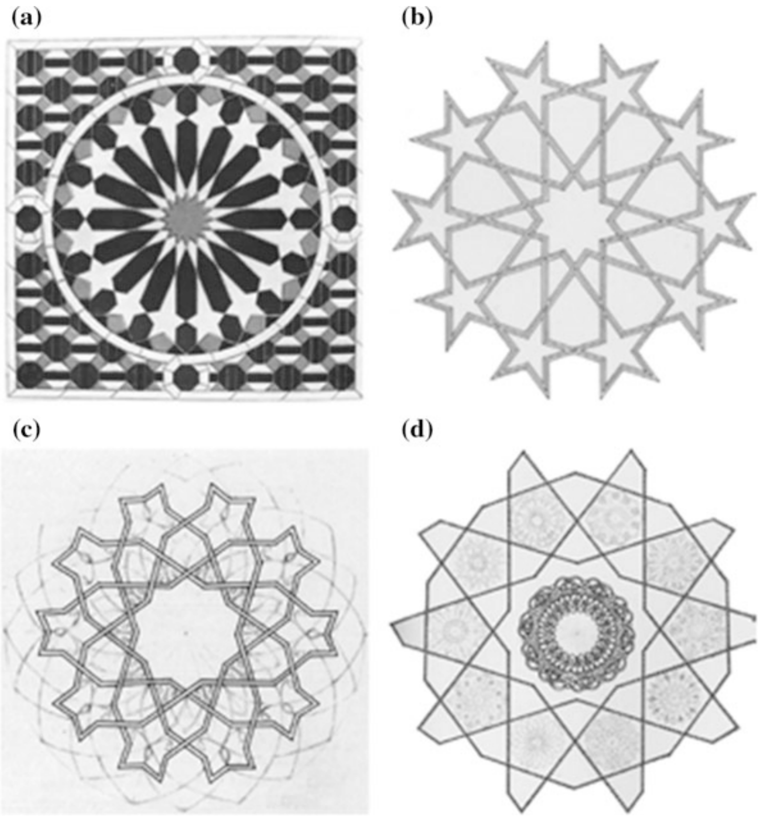

Fig. 9 Ceramic decoration as a visual sign of multiculturalism: **a** "*floron alicatado*" in the cloister of the monastery of Poblet, Spain (M. Gonzales Marti 1952); **b** examples of 'starred' geometric decorations, similar to the previous construction (by Osama Mansour 2014); **c**, **d** examples of decoration based on the geometry of the circle and inspired by the gilded plaster decorations of the mosque of Al-Aqsa in Jerusalem (Osama Mansour 2014)

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Villa Farnesina in Rome. Contributions to Its History

Cesare Cundari, Giovanni Maria Bagordo, Gian Carlo Cundari and Maria Rosaria Cundari

Abstract Villa Farnesina, built for Agostino Chigi, is the most famous sixteenth-century building in Rome. With authorisation from its owners, the Accademia dei Lincei, a study began on the building in late 2013. The study involves a critical interpretation of the building and its environment in order to reconstruct not only the various stages of its construction, but also the figurative works by Baldassarre Peruzzi, Sebastiano del Piombo and Raphael. The study uses survey as a critical interpretation tool with a view to developing an interactive information system.

Keywords Villa farnesina · Baldassarre peruzzi · Survey and knowledge

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1 Introduction

Commissioned by the banker and patron of the arts Agostino Chigi, in 1505 building began on Villa Farnesina at the foot of the Janiculum Hill in Rome. Only later in 1579, when Cardinal Alessandro Farnese purchased the building, was it given the name with which it is world famous.[1]

The building is famous primarily due to the important mythological and allegorical paintings in its main rooms; the images were executed by extremely talented and ingenious artists, first and foremost Baldassarre Peruzzi (who was also involved in its design) Rafael and Sebastiano del Piombo.

When completed around the year 1515 the Villa included a main building (the focus of this essay), another building used as stables[2] facing Via della Lungara (designed by Rafael) and, above a grotto on the Tiber, a third, small building used as a place of pleasure and relaxation [3](Fig. 1).

The three buildings were surrounded by a huge garden which, with different characteristics, stretched from Via della Lungara to the Tiber.

Since then the overall plan of the Villa has been radically altered. The extremely dilapidated Stables were demolished in 1808,[4] replaced by a pre-existing building that was turned into an Auditorium in the first half of the twentieth century.[5] In addition, the construction of the banks of the Tiber (in the 1880s) and roads running along the river severely curtailed the surface area of the gardens. As a result, the sumptuous Villa built by Agostino Chigi during the first two decades of the sixteenth century no longer exists; all that remains is the main building and a much smaller garden. In this essay we will refer to this building as the "Villa". The goal of our analysis was to establish Peruzzi's design criteria and the building's original configuration (Fig. 2).

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[1]In old cartographic representations it is marked as "Vinea. D. Ghisi" (Bufalini, 1551) or "Ghisi" (Tempesta, 1593). In Maggi's view (1625) the property is described as "Giardino De Farnese. La Longara"; in G. G. De Rossi, the re-edition of the view by A. Tempesta (1693) it is noted as "P. de Ghisi oggi Farnese".

[2]The building has three floors accessed by staircases; it could accommodate up to 100 horses and most likely even a guesthouse. Frommel published extensive graphic and reconstructive archival documentation (cfr. pp. 49–69). The first reliable image of the building (corresponding to later views) is contained in the representation of Rome by Antonio Tempesta (1593).

[3]No documentation has survived regarding this building of the Grotto. A partial view of the building is represented in several views of Rome (Tempesta, 1593; De Rossi, 1661/2 and 1693). See, in any case, the contribution by…. Ray, *La loggia della Farnesina sul Tevere: una ricostruzione e "il caso dei disegni assenti"*, in *"Il disegno di architettura"*, Proceedings of the (Milan 1988, pp. 191–208).

[4]Cfr. Frommel, op. cit., p. 70.

[5]During the post-1944 restoration by A. Terenzio and G. Massari (see note 10c) all the walls inside the garden were demolished, as were the annexes and outhouses (in line with the idea of "freeing" the main building in the complex). A building that already existed in the area of the Stables and its entrance courtyard was turned into an Auditorium designed by M. Piacentini.

Fig. 1 Villa Farnesina, north façade

Fig. 2 Aerial view of Villa Farnesina as it stands today. To the right, note the road running parallel to the river. Its construction caused the famous gardens to be drastically curtailed in size

2 Salient Events in the History of the Villa

Like almost all old buildings, the current Villa Farnesina is very different to what it was when it was first built. In December 2013—in agreement with the Accademia dei Lincei (owners of the property)—we initiated a study focusing primarily on identifying the main construction phases of the building using a new advanced technology survey. We also carefully analysed its structure and functions [6](Fig. 3).

Since the study is still ongoing, this contribution will present only the preliminary results.

Our study shows that during the heyday of Agostino Chigi's activities as a banker he began the construction of the Villa primarily as a representative office that would reflect his new-found status at the Papal court.

Born in Siena on 28 November 1466, Agostino Chigi was the son of a Banker from Siena. While working in the Viterbo offices of his father's bank he had done business with the Papal State and had become familiar with its financial activities. In Spring 1487 he moved to Rome where in 1476 his father had already rented a property in the *Banchi* district. Assisted by his father, Agostino Chigi founded his first company. While working in papal circles he witnessed the construction of works destined to be extremely important in the history of art, and architecture in particular: for example, the Belvedere built by Innocent VIII (decorated by Mantegna and Pinturicchio) and Palazzo della Cancelleria.

During the reign of Pope Innocent VIII (Giovan Battista Cybo, 1484–1492) bankers from Siena had not had many opportunities to work in the Papal State. In 1492 they were once again in favour thanks to the election of Pope Alexander VI (Rodrigo Borgia) who reinstated the Spannocchi family as the tax collectors of the Church. Thanks to a strong links between the two families Alessandro Chigi worked with Spannocchi family.

Although Agostino Chigi was an unscrupulous financial operator, his real wealthy came from his exploitation of the alum mines in Tofa; in fact, in 1505 he had been granted a concession for the mines by the Apostolic Chamber in exchange for a payment of 34,000 ducats per annum. Alum was a mineral used to dye fabric; until then it has been imported chiefly from the Turkish Empire. Chigi managed to rationalise the mining process and boost trade in Europe and Asia during the

[6]Apart from the authors of this contribution, other experts participated in the study: Prof. Andrea Giordano, University of Padua (focusing primarily on the perspective and figurative elements in the Hall of Perspectives); the architect Beatrix Jaczko, the engineer Giuseppe Antuono and the p. i. Salvatore De Stefano. The building had already been surveyed by Girolamo Toma who produced three plans, an elevation and two sections; the graphic images were published by A. Schiavo in 1960 (in *L'architettura della Farnesina*) in "Capitolium", 8, pp. 2-14; Crossi and E. Piccione who also drafted several plans of the north and south façades as well as two sections; the drawings were published in *Il rilievo della villa Farnesina Chigi* and reproduced by several scholars.

Our historical and critical observations regarding the Villa have been based on the numerous authoritative studies performed on Villa Farnesina, including the monumental *La Villa Farnesina a Roma* curated by Christoph Luitpold Frommel and published by Franco Cosimi Panini in 2003.

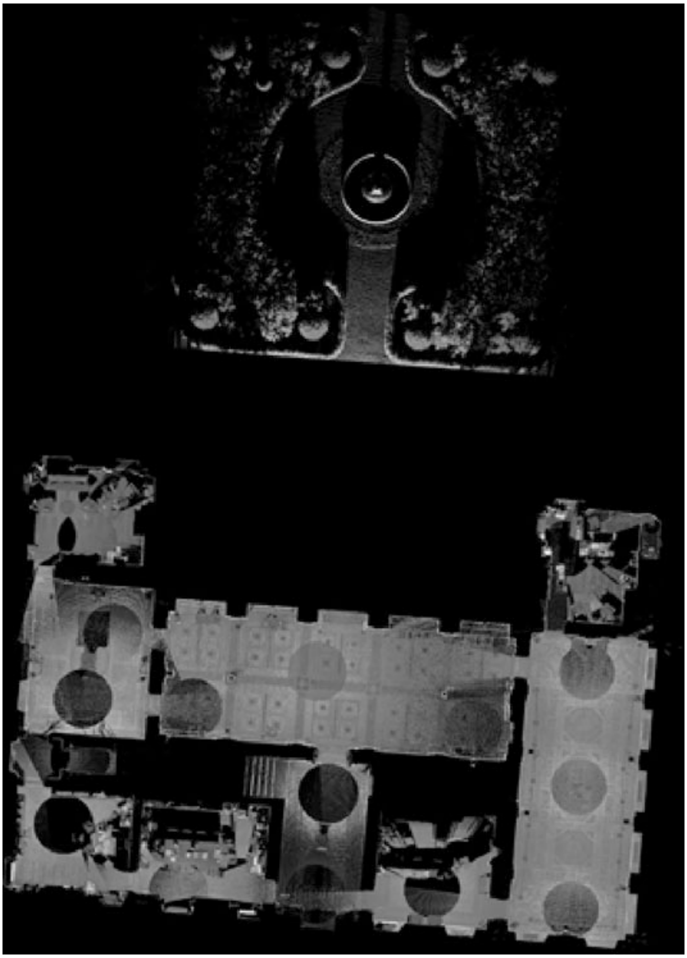

Fig. 3 Horizontal section of the merger of the points clouds recorded on the ground floor of the Villa

papacies of the three popes elected after Alexander died (Pius II, Julius II and Leo X). He also tried to turn his activity into a monopoly. In 1520 Chigi earned 300,000 ducats per annum from his alum business.

Agostino had been working in Rome for thirty years when in 1502 he created a new company and finally came out from under his father's shadow. His successful financial activities, and the fact he needed to establish himself as a member of the circle of powerful men during that period in history, prompted him to build a suburban villa like many other important members of the papal court, for example Cardinal Riario. The latter had recently begun to build a new residence along Via Lungara, an area outside the walls at the foot of the Janiculum Hill in a strategic position vis-à-vis the Vatican and the old centre of Rome, most of which was situated on the other side of the Tiber.

It's very likely that from 1487 to 1511 Agostino lived in Rome in the building in the Banchi district with his wife Margherita Saracini (who died in 1508 without bearing children). In fact, 1511 was the year when the first construction phase of the new residence in via della Lungara was completed.

3 The Design Assigned to Baldassarre Peruzzi and the First Construction Phase

On 14 May 1505 Agostino Chigi spent 530 ducats to buy a vineyard along the same road, outside Porta Settimiana. The area lies between the southern part of Via della Lungara (perhaps designed by Antonio da Sangallo the Elder, to the west) and the Tiber (to the east). To the south, the land bordered other gardens where Alessandro Farnese had built a spacious residence before being named Cardinal in 1493, while the property to the north belonged to Mario Cuccini. A few years later Agostino bought the property in order to enlarge the Villa. During that period (probably in the same month of May) the banker assigned the design of the Villa to Baldassarre Peruzzi. Peruzzi, also from Siena, was the son of a weaver. He was born in 1481 and was probably the student of Francesco di Giorgio, and maybe even of Matteo di Giovanni. He had moved to Rome around 1503 while his half-brother (the painter Pietro D'Andrea) was working on the decoration of the loggias of the Borghese fortress in Civita Castellana. His first documented work was the decoration of the dome of the chapel of St. John in the Cathedral in Siena in 1501. It appears he had already worked for the Chigi family, successfully designing Villa Le Volte near Siena for Agostino's brother Sigismondo.[7] As an employee of Agostino Chigi, the young Peruzzi certainly had many more opportunities to improve as an architect. This was the period when Bramante designed the cloister of Santa Maria della Pace, Palazzo Caprini, the Small Temple in St. Peter's in Chains, and had begun work on the Belvedere Courtyard.

During that period Agostino Chigi was a habitué in papal circles; there he developed a keen interest and insight in the world of art and began to understand the importance of artists and their works.[8]

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[7]In the first edition of the *Lives*, Vasari wrote: "… having returned to Rome, Baldassarre formed a very strait friendship with Agostino Chigi […] And thus, with the help of so great a man, he was able to maintain himself while studying the antiquities of Rome, and particularly those in architecture…". Cfr. Frommel, op. cit., p. 16.

[8]Agostino could not remain indifferent to events in Rome during that period; several artists were working there including Perugino (Pinturicchio), Mantegna, Botticelli and Bramante. After the death of Lorenzo the Magnificent and the departure of Baccio Pontelli from Rome in 1492, Giuliano da Sangallo had become the personal architect of Cardinal Giuliano della Rovere and in 1504 the second papal architect after Bramante.

Agostino Chigi decided to entrust Baldassarre Peruzzi with the design of the villa that was to testify to his success; maybe he did so out of love of his native land, but it's (perhaps) more likely that he wanted a greater say in its design and technical choices. And the young age of this promising artist was a perfect opportunity.

Between 1505 and 1520 (the year he died) Agostino Chigi influenced and controlled two stages of the construction of the Villa (Fig. 4).

After Agostino died, the Villa passed hands more than once. In 1579 Alessandro Farnese became the owner; in turn he bequeathed it in his will dated 22 June 1587 to his universal heir Odoardo, son of the Duke of Parma, also granting him use of the estate during his lifetime.[9] Although in 1638 when Gaspare Celio described the Villa he stated that Peruzzi's paintings on the façade were still in place, by the mid-seventeenth century the Loggia of Galatea[10] had been plugged and by the end of that century all the paintings had been restored by Carlo Maratta.[11]

When Antonio Farnese died without direct heirs, in 1731 the villa passed on to Elisabetta, wife of Philip II Bourbon, King of Spain and his son Don Carlos, the future King of Naples. In September 1735 the Bourbons decided to use the Villa as the seat of an *Academy of Neapolitan art*. The academy remained in the Villa until 1840. On 19 June 1861 the complex was entrusted for ninety-nine years to the Ambassador of Spain to Naples, Salvador Bermudez de Castro, Duke of Ripalta[12] on the condition that he took care of the building and paid all taxes. That same year the architect Antonio Sarti drafted several important preliminary projects involving significant consolidation work and refurbishment of two rooms of the living area; the plan also included shifting the entrance to the south façade and downsizing the attic on the east wing.[13]

In the 1880s the gardens were scaled down due to the construction of the banks of the Tiber. Finally, on 15 February 1927, the Villa complex was purchased by the Italian State.[14]

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[9]Cfr. Frommel, op. cit., p. 68.

[10]When the arches of the Loggia were plugged the new walls were painted with landscapes (by the Roman school) while the restoration of the grotesques of the pilaster-strips was entrusted to Paolo Marescotti from Modena. Cfr. Frommel, op. cit., p. 69.

[11]Maratta's restoration is described in detail by Bellori.

[12]The Act is housed in the archives of the Accademia dei Lincei.

[13]The survey by architect Sarti is dated 13 June 1861. Based on indications by Sarti, the survey was performed by the architect Antonio Cipolla in 1861–63 (cfr. Frommel, op. cit., p. 70). Lodovico Seitz decorated the new antechamber. Around that date the shutters on the windows and the decoration of the vaults of the main staircase were also executed.

[14]The Villa was sold in 1929 to the Reale Accademia d'Italia and, after it was disbanded in 1944, to the re-founded Accademia Nazionale dei Lincei. Important restoration work was performed and supervised by A. Terenzio and G. Massari. On that occasion the façades were painted, covering much of the residual traces of the decorations by B. Peruzzi. More recently, the Central Institute of Restoration of the Ministry of Cultural Heritage and Activities has repeatedly intervened, above all in the two Loggias and the Hall of Perspectives. At present, restoration is ongoing on the Corridor of the Grotesques next to the rooms to the east of the Hall of Perspectives.

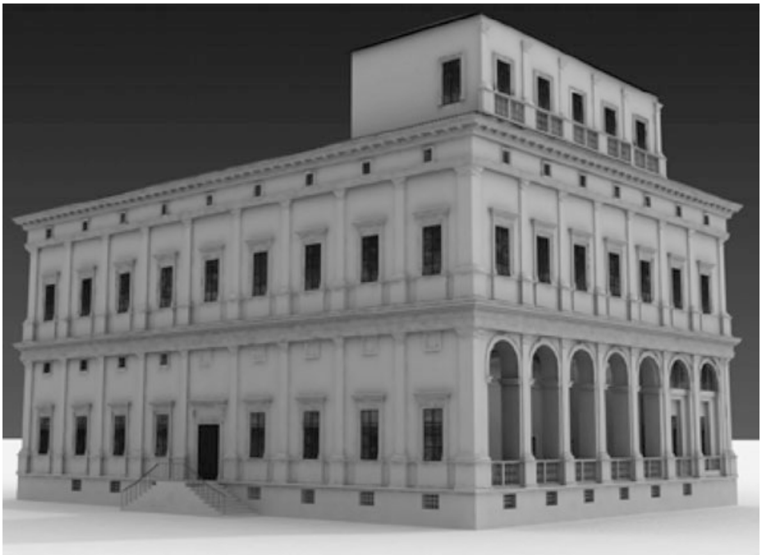

Fig. 4 The east and south façades of the reconstructed virtual model of Peruzzi's design of the Villa

Over the centuries the alterations implemented after the first construction phase (which ended in 1511) have radically changed the layout of the building.

By comparing the survey in 1511 with our survey and studies, the following observations can be made:

- the relationship between the building and the surroundings has changed;
- the complex vertical access between floors has been altered;
- during the second construction phase (1518–1520) the layout of the first floor was altered (to create what was to become famous as the *Hall of Perspectives*) and so was the staircase leading down to the basement and up to the upper floors;
- in the mid-seventeenth century the arches of the Loggia of Galatea were plugged and all the unpainted indoor surfaces were frescoed; this led to a radical change in their perception and fruition;
- numerous consolidation projects (especially in the nineteenth and twentieth centuries) caused invisible changes (e.g., replacement of the ceilings) and visible changes (breaking up the old sitting room on the raised floor and rooms underneath based on plans by the architect Sarti). In addition, reinforcement during the twentieth century drastically changed some of the rooms in the basement;
- the overall volume was repeatedly altered: the attic towards the Tiber built on top of the east wing of the building (probably during the second construction phase) was later reduced in size.

4 Analysis of the Building and the First Construction Phase

The aim of the study, still to be completed, was the virtual reconstruction of the construction phases of the architectural complex. The main issues included the original relationship between the building and its surroundings and the access system between the various floors. The first issue is crucial in order to fully understand the artistic "dimension" of Peruzzi's design (and the intentions of his client/patron). In his project Peruzzi brilliantly merges architectural and figurative design, but also makes the architecture compatible with other forms of artistic expression, for example, the staging of plays. Two panegyrics in 1511–12[15] praise the magnificence of Chigi's Villa while several accurate iconographies describe the architectural solution employed for the Loggia of Cupid and Psyche. Although it was already used as the entrance to the Villa, after Peruzzi's changes it also became the backdrop of the stage naturally located between the two, north-facing wings of the Villa next to the Loggia. When the actors were on stage they were also able to talk to other actors looking out from the windows of the side buildings. The stage was raised compared to the garden so that guests could sit in the garden and watch the plays. Today the situation is very different: the garden has been raised and has incorporated the base of the building (Fig. 5).

After performing a critical survey of the building and studying the sources, we carefully examined Peruzzi's design criteria and the vertical access system. It was thanks to this project that Peruzzi became an authoritative member of the Roman milieu. After concluding our studies we are now able to illustrate the hypothetical reconstruction of the 1511 version of the building using virtual modelling tools to verify our hypothesis regarding its size and structure.

At the end of the first construction phase between May 1505 and 1511, Agostino Chigi's suburban Villa complex was still not very large, but it was very attractive not only thanks to the features of the building (described later), but also and above all for its gardens and the building above the aforementioned Grotto along the banks of the Tiber which must have nestled nicely into its surroundings. In fact, while the main Villa was being built it had been repeatedly used for banquets and events.

On 8 June 1510—a full five years after buying the first plot of land—Chigi succeeded in purchasing the plot to the north owned by Cuccini. This allowed him

[15]Reference is made to the *Suburbanum Augustini Chisii* by Blosio Palladio and to the *De viridario Augustino Chigii* by Egidio Gallo. In 1505 Egidio Gallo had dedicated two plays to Agostino Chigi; it is likely they had been staged in the building in the Banchi district where Chigi had lived before moving to his new residence. Since Gallo lived in Rome, he had witnessed the construction of Villa Farnesina from the start. At the beginning of the panegyric he expresses his delight regarding Chigi's return to Rome on 21 August 1511 (this helps to date the work). Blosio Palladio was far more important than Gallo; since 1506 he had been one of the most important members of the Roman Academy founded by Pomponio Leto; in 1516 he was made a Roman citizen. (cfr. Frommel, op. cit., p. 20).

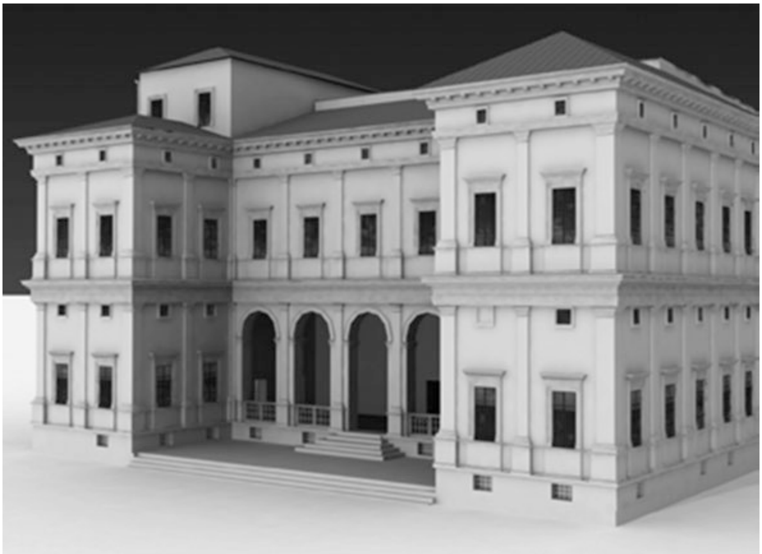

Fig. 5 The north and west façade of the reconstructed virtual design of Peruzzi's Villa. Note the stage between the two wings of the Villa

to enlarge the gardens of the Villa (in practice doubling its surface area) and build the Stables (designed by Rafael) next to Via della Lungara.

In November 1511 the building was coming along so well Chigi could invite Pope Julius II to the Villa for the first time.[16]

In the winter of 1510–11 Chigi had entrusted Rafael with several commissions: the decoration of the new residence—the Galatea fresco (in the Loggia of Galatea), the fresco of the ceiling of the Loggia of Cupid and Psyche—and the design of the Stables.

At the end of the first construction phase the main building of the Villa (with a roof) had a basement and four above ground floors (two main floors and two mezzanines). The open side of the U-shaped plan faced northwards. The kitchen and storerooms were in the basement; the raised floor was used to receive guests. It included two communicating loggias: the first (Cupid and Psyche) faced the north entrance and gardens, while the Loggia of Galatea faced east towards the Tiber. To the south, a large parlour with a fireplace was located in a corner between the two loggias and communicated with them, thus providing access to a reserved part of the garden (the "secret garden"), to two rooms used as pantries (facing south) and to big staircase leading to the upper floors.

Agostino Chigi's office with a big antechamber was on the same floor (in the northern part of the west wing of the building); the antechamber could be accessed

[16]Cfr. Frommel, op. cit., p. 24.

through the Loggia of Cupid and Psyche. A staircase must have connected the antechamber and the rooms used as pantries (facing south); the staircase also led to the basement (with the kitchens) and extended under the main staircase from the raised floor to the first floor. The office of the learned Cornelio Benigni, Chigi's clerk, was located in the east wing of the building to the north of the Loggia of Galatea [17](Fig. 6).

Both loggias were open; the one to the north towards the gardens and the one to the east towards the Tiber.

The first mezzanine between the first and second floor still exists; it is divided into three, non-communicating parts (at slightly different levels). The three parts are located above Chigi's study and antechamber, the two rooms used as pantries, and the clerk's office. In practice the first mezzanine does not extend to the two Loggias and large parlour because their ceilings were higher than the ceilings in the other rooms.

The first floor was reserved for the family while the second mezzanine was most probably used by the servants.

In some of the old views of the city of Rome the Villa has another floor on the east wing (facing the Tiber). This floor has five windows towards the river just above the Loggia of Galatea.[18] This floor was almost certainly finished after 1520 because there is no mention of it in the aforementioned panegyrics (1511–12) decrying the beauty of the Villa. If it had already been built these panegyrics would never have omitted to mention this part of the building which was (and is) a beautiful belvedere towards the Tiber and old city (Fig. 7).

Several mid-sixteenth drawings show the building almost parallel to and not far away from Via della Lungara with its axis in an almost north-south direction and its façades completely covered in elegant statues.[19] As mentioned earlier, the garden was at least 60 cm lower than it is now; a terrace that could be used as a stage for plays was located between the two wings of the building which, to the north, are located on either side of the Loggia of Cupid and Psyche.[20]

The gardens stretched between Via della Lungara and the Tiber; they were carefully cultivated with herbs and plants recently imported into Europe from the faraway Americas, discovered just fifteen years earlier (in fact numerous fruits are depicted on the vault of the Loggia of Cupid and Psyche). The extensive gardens were divided into two main areas: the "secret garden" south of the building,

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[17]As clerk to Agostino Chigi, Cornelio Benigni undoubtedly helped to make the new villa a meeting place for artists and men of letters. It's important to recall that Benigni persuaded Chigi to print the original version of works by Pindar (in 1515) and Theocritus (in 1516) in the rooms of the Villa.

[18]Cfr. The *Veduta del Tevere nel 1754* by Giovanni Vasi in *Magnificenze di Roma antica e moderna*, Roma, (1754) and, still earlier, the *Pianta di Roma* by Etienne Dupérac (1577).

[19]Cfr. Drawn by Anonymous, Flemish, elevation of the façade; c. 1560 (New York, Metropolitan Museum, Inv. 49.92,53 r) published by Frommel (op. cit., p. 34).

[20]Cfr. The view drawn by Anonymous in the first half of the sixteenth century (Florence, Uffizi, Dept. Of Prints and drawings, Inv. 365 A r) in Frommel (op. cit., p. 33).

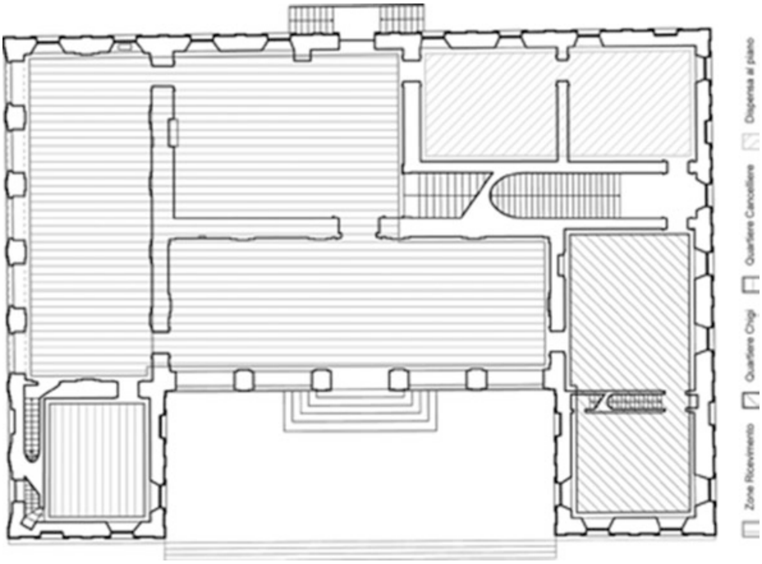

Fig. 6 Reconstructed plan of the ground floor of the Villa in 1511

Fig. 7 The east façade of the reconstructed virtual model of Peruzzi's design of the Villa. Note the Galatea Loggia, open towards the garden, and the attic above

accessed through the former parlour (with its geometric layout) whilst the rest of the garden stretched north and east down to the banks of the river.[21] The garden also included several outhouses as well as the main courtyard and stable courtyard.

The building was very different to what it is today. After chronologically establishing the work executed by the various artists, we know, for example, that before the end of 1511 Peruzzi had completed the decorations of the vault of the Loggia of Galatea as well as the *Head of a Young Man* (in the right lunette of the north wall); Sebastiano del Piombo had painted all the lunettes and *Polyphemus* (on the west wall), while Rafael had painted the fresco of *Galatea* next to *Polyphemus*.

The delightful loggia, with its railing and five arches, faced east towards the gardens and the Tiber.

During that period the Loggia of Cupid and Psyche, with the vault allegedly frescoed by Rafael and his collaborators, was used as a north entrance. Access not only to the Loggia, but also to the room between the parlour and the room through which one accessed the "secret garden", was located along the central axis of the building. As mentioned earlier, the parlour communicated with the Loggia of Galatea; the covered area of the two loggias and the parlour were used for receptions.

Studying the layout of the raised floor one realises that the Hall of the Frieze to the west could be accessed through the Loggia of Cupid and Psyche. From the Hall of the Frieze it was possible to either turn northwards and access Agostino Chigi's study or turn southwards towards a passageway (and from there to a staircase leading down to the kitchens in the basement) and to the two service rooms through which it was possible to access the parlour. The main staircase leading from the first mezzanine to the first floor was located between these two rooms and the wall next to the Hall of the Frieze and the Loggia of Cupid and Psyche.

Agostino's study was located in the west wing of the building in an important position facing north so that his windows gave onto the entrance to the Villa as well as onto the north gardens and Via della Lungara.

It's important to point out that two walls separated Agostino's study from the Hall of the Frieze; between these two walls a staircase led to all the fl Ancient iconographies[22] document the existence of the two walls as well as traces of the steps in the above-ground fl However, over the years they have been almost completely demolished and replaced by fl Peruzzi's design gave Agostino the exclusive use of a large part of the building (two rooms on each fl A staircase (albeit modifi during the fi half of the last century) still leads from the Hall of the Frieze down to the basement.

In the same plan, Cornelio Benigni's study is shown on the opposite side (eastwards) in a symmetrical position to Agostino Chigi's and north of the Loggia of Galatea. It also has a mezzanine and an internal staircase between the two floors (later modified). The staircase in the basement underneath leading from the kitchens

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[21]Cfr The Plan by Nolli (1736–1734).

[22]Cfr. The survey by Paul Letarouilly dated 1840 (in Frommel, op. cit., p. 42, Fig. 44).

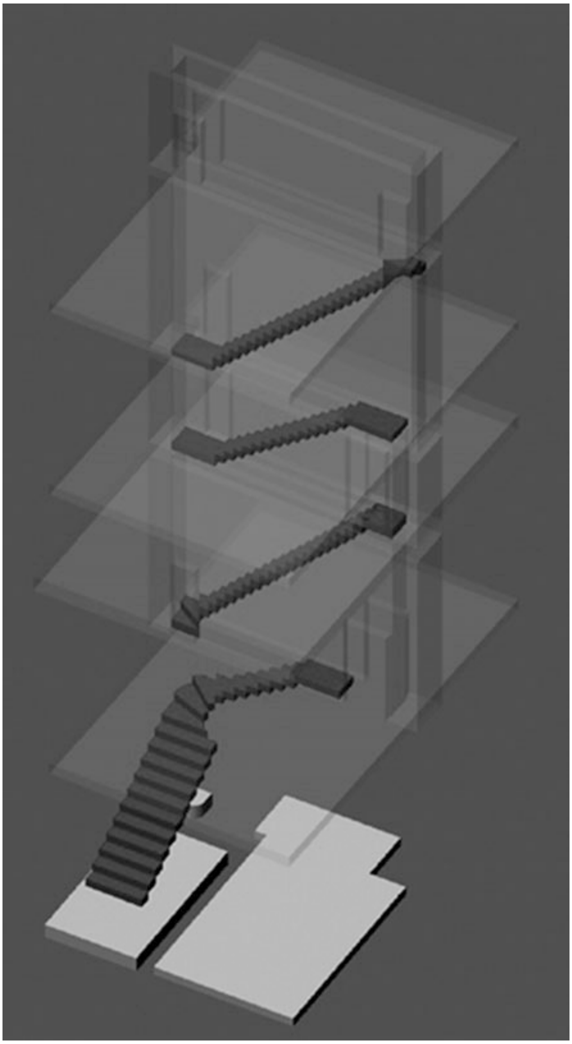

Fig. 8 Diagram showing reconstruction of the Agostino Chigi's personal staircase

directly to the Loggia of Galatea was also later broken into two parts, although the wall structure is still visible (Fig. 8).

Finally, the rooms on the first mezzanine above the two south-facing rooms used as pantries could be accessed in a rather unusual way: from the first flight of the main staircase.

To complete the reconstruction of the configuration of the building at the end of the first construction phase, and based on available surveys and sources, we will verify what happened during the second construction phase of the building and what changes were made to its plan.

5 The Second Construction Phase

Agostino Chigi had a very intense love life. After his wife Margherita Saracini died in 1508 he became attached to a courtesan (Imperia) who bore him a daughter (Lucrezia) and who later died on 15 August 1511. In 1510 Chigi had met Margherita Gonzaga whom he would have liked to marry. In the meantime, in 1512 he had begun to see Francesca Ordeaschi who gave him five sons and who he decided to marry in 1519. In 1518, before the upcoming marriage, Agostino commissioned Baldassarre Peruzzi to design a new hall on the first floor of the building; Chigi intended to use the hall as the venue for his marriage festivities. On 21 August 1519, Chigi's name-day, the marriage was celebrated "*in aula superiore domus*". The new room is known as the *Hall of Perspectives*. The trompe-l'oeil paintings on the walls were undoubtedly finished before the celebrations. Together with the decoration of the vault of the Loggia of Galatea, they successfully testify to Peruzzi's expert use of geometry and perspective, and especially his architectural figuration.

To create the magnificent Hall Peruzzi had to alter the wide staircase between the two main floors. At present we can say that the two flights have different gradients and the ceilings above each flight are also different. Authoritative scholars – including Frommel, repeatedly mentioned, and considered the most authoritative scholar regarding this building – emphasise how to make room for the new hall Peruzzi had to alter the first flight of the main staircase; however he was unable to avoid a small part of the extrados from jutting out of the new floor (at the extreme west edge of the room).[23] Using laser scanners and virtual modelling, tests are being carried out in order to elaborate an organic theory regarding the original design of the staircase which undoubtedly provided access to the second mezzanine. Furthermore, all available data points to the fact that, before construction of the new Hall, all the first floor rooms were equal in size (and height) and that the second mezzanine extended throughout the entire floor.

6 Conclusions

The building has so far been analysed using survey and digital modelling; we have been able to reliably reconstruct the probable configuration of the building at the end of the first construction phase (including its measurements). Our analysis has revealed Baldassarre Peruzzi's excellent skills and expertise. Not only does he brilliantly control the spatial layout of the building and create a private area for

[23]For many years scholars proposed this interpretation of the building. However based on our surveys we found no evidence to support this theory. In particular, a different gradient between the two flights of steps emerged for the main staircase. Absolutely regular for the first flight and its vault, and an irregular configuration for the second flight.

Fig. 9 Villa Farnesina; the vault of the Loggia of Galatea. 9, pp. 3–9). In 1984 more surveys were performed by M. C

exclusive use by Agostino Chigi in what was a predominantly communal space, but he also skilfully uses geometry and perception in the fresco of the vault of the Loggia of Galatea. All the pseudo-architectural elements between the frescoed areas are pure illusion. The digital survey has confirmed the absolute continuity of the vaulted surface. Peruzzi's successful images in this vault undoubtedly pre-empt the figurative style that a few years later was used for the Hall of Perspectives (Fig. 9).

Notes

Several authors have inputted into this study. As a mere evaluative element the authors are listed as follows: Cesare Cundari (*Introduction*, *Conclusions*); Giovanni Maria Bagordo (*Salient events in the history of the Villa, The design assigned to Baldassarre Peruzzi and the first construction phase);* Maria Rosaria Cundari (*Analysis of the building and the first construction phase*); Gian Carlo Cundari (*The second construction phase*).

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Three-Dimensional Nature of Architecture and Its Representation: A Suspension Bridge Between the Interpretations of Italian Treatise Writers of the Sixteenth Century and the Processing Methods of the Contemporary Era

Giuseppa Novello and Massimiliano Lo Turco

Abstract The paper is intended to deepen a specific theme, which affects almost uninterrupted continuity the architectural culture, related to the relationship between three-dimensional nature of architecture and its representation; the topic is developed through critical reflections on the relationship between the concept of spatial designed conformations and the expressive forms of figuration drawn, figured as interpretations qualified by distinctive knowledge values. We try to answer to the following questions: which products can be compared with the representative transcriptions of the past? Is it possible to define some common elements or the differences are too substantial to evoke an unlikely continuity?

Keywords Representation · Historical treatise · Digital era

Cum in omnibus enim rebus, tum maxime etiam in architectura haec duo insunt, quod significatur et quod significant. Significatur proposita res, de qua dicitur; hanc autem significat demonstratio rationibus doctrinarum explicata. Quare videtur utraque parte exercitatus esse debere, qui se architectum profiteatur. Itaque eum etiam ingeniosum oportet esse et ad disciplinam docilem. Neque enim ingenium sine disciplina aut disciplina sine ingenio perfectum artificem potest efficere. […] Deinde graphidis scientiam habere, quo facilius exemplaribus pictis quam velit operis speciem deformare valeat. Geometria autem plura praesidia praestat architecturae; et primum ex euthygrammis circini tradit usum, e quo maxime facilius

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aedificiorum in areis expediuntur descriptiones normarumque et librationum et linearum directiones. Item per opticen in aedificiis ab certis ragionibus caeli lumina recte ducuntur. (Marcus Vitruvius Pollio, De Architectura, Libro I)

Perche se in cogni altra cosa, come specialmente nell' Architettura, queste due parti si trovano cioè la cosa significata, & quella, che significa, la cosa significata, è l'opera proposta, della quale si parla. Quella, che significa, è la prova, & il perche di quella, con maestrevole ragione di dottrina espresso, & dichiarito Donde adviene, che chi fa professione di Architetto pare, che nell'una, & ne l'altra parte esser debbia essercitato, cioè nella cosa significata, & nella significante. Dove & ingegnoso, & docile bisogna che egli sia, percioche nè lo ingegno senza lo ammaestramento, nè lo ammaestramento senza lo ingegno puo fare l'huomo eccellente. […] Appresso habbia disegno, accioche con dipinti essempi, ogni maniera d'opera, che egli faccia formi, & dipinga. La geometria giova molto allo Architetto, perche ella insegna l'uso della linea dritta, circolare, dal che poi agevolmente ne i piani si fanno i disegni de gli edificii, & le dritture delle squadre, dei livelli, & de i lineamenti. (*I dieci libri dell'Architettura di M. Vitruvio, tradotti e commentati da Mons. Daniel Barbaro* […])

1 Foreword (GN)

The reasons that suggested me to develop this topic to answer to the EGA 2016 Congress, requires a foreword that I expose briefly below, introducing useful to clarify the context within which the issue was addressed.

At the Politecnico di Torino in 1999 it was set up the Doctorate School, an organization dedicated to the coordination of activities related to the Ph.D. It was the first university in Italy to adopt a similar institution, and it has activated for the XXXI cycle sixteen Ph.D. courses (Civil Engineering and Architecture, Information Technologies and Communications, Industrial Engineering, and Physical Sciences, Chemical and Mathematical Sciences for Engineering areas). The title of the Ph.D. Degree awarded at the end of the course of study is internationally recognized. The Ph.D. program in Architectural and Landscape, which I took part since its inception, is part of this system of higher education post-graduate.

In Italy this third level degree of university education has three years of curriculum and includes a series of training programs specifically designed for the purpose of transfer to Ph.D. students a scientific culture and advanced technical and methodological tools to conduct research in their chosen field. After completing the course the PhDs will have acquired the scientific and organizational skills to carry out, with cultural autonomy and collaborative capabilities, research activities not only in universities but also in the other bodies and institutions, public and/or private, engaged in managing innovation in the areas of reference, to form a network of relations between the academic world and the production system.

At the regard, the Architectural and Landscape Ph.D. course is characterized by a distinctly multidisciplinary educational path—does not deal exclusively of

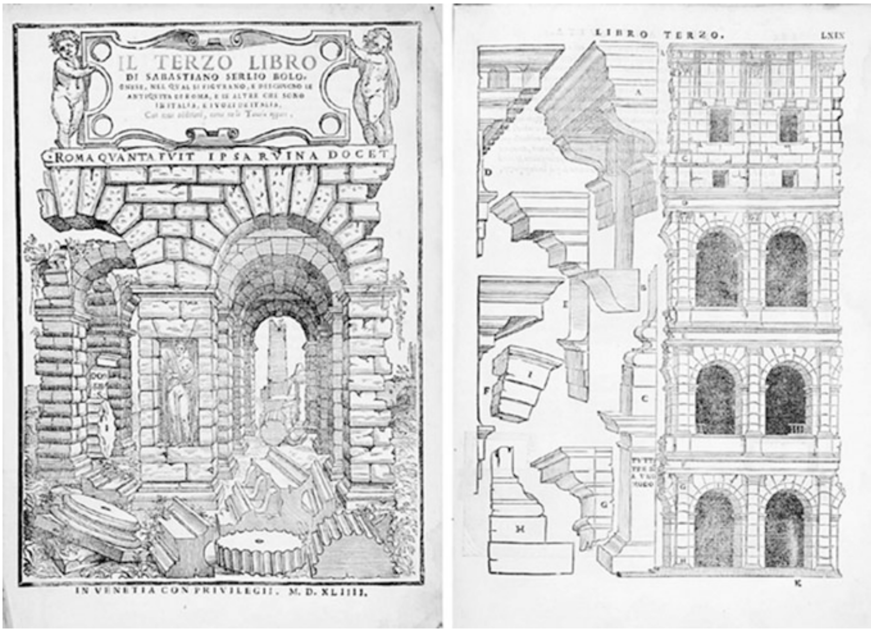

Fig. 1 Sebastiano Serlio Bolognese: the cover of the Third Book, which is part of his treatise in Seven Books, seems to be the manifesto of the rule adopted to represent and describe the antiquities of Rome. The method of *decomposing and recomposing* parts, is connected with three-dimensional views of related details with the assembly drawings. Title page and Table LXIX, on the orders of the Coliseum, features Venetian edition (1544; first edition is dated 1540)

Surveying and architectural, urban territorial and environmental Drawing—with a organizational and teaching set up and anchored in a very articulate intersectoral vision. Coordinated by a professor elected from among the members of the School Committee, it is qualified by the presence of professors, experts and scholars, referring to different research areas (history, restoration, drawing and survey, engineering, geomatics, cost accounting) offers a wide range of training collective and individual opportunities, which provide, among other things, a series of multidisciplinary seminar appointments, which all students are required to attend, harmonized with other moments more strictly dedicated to disciplinary in-depth analysis (Fig. 1).

2 The Art of Representation Communicates and Integrates Knowledge (GN)

The contributions given by the representation area, committed to concretely reaffirm its essential distinctive presence, are coordinated with the above setup, necessary and not only fit, to ensure a consistent approach to the complexity of the issues that the scope of architectural and environmental heritage demands. Drawing is a broker of expressive values and cognitive intentionality; it is a term with many meanings, an interpreter and often the protagonist in many activities of analysis, investigation and heritage project of architectural and landscape (Docci 2008). It is recognized as a communication language to describe, appear, exposing theses, proving hypotheses. In my view, the issue not resolved is linked to this instrumental use of graphic language made by many applicant and scholars who invoke it, in its own right, but which basically express complementary interests with respect to research the centrality of those involved in drawing and survey. Historians, restorers, geomatics, technologists often use drawings and representations in their studies, some with expressive sensitivity and skill, but rarely thought on scientific matters investigated by our research area (De Rosa 2000). An example to clarify this concept could be that inherent in our studies, that investigates the established relationship between represented entities and graphic transcription codes, or dealing with the relationship between production technology used in practice, and theoretical basis of the geometric methods, or even those research aimed at deepening the distance between the two-dimensionality of the drawings and the three-dimensional nature of the physical scenario that describe those drawings (De Rubertis 2002).

The last issue, which always concerns with the architectural culture was often subject I treated within the multidisciplinary seminar named *History and analysis of cultural heritage: issues and problems*. It was proposed at the beginning of the common Ph.D. training activities, with the purpose to be a basic course. For the 2014–2015 academic year the specific subject, indicated by the coordinator, the historian Francesco Paolo Di Teodoro, named The *architectural drawing: from the ancient to the present* suggested me to explain to graduate students some reflections on *Graphic architectural representation: gleanings between questions of form and measurement*; my participation, inserted within a composite system of contributions by other scientific fields, has focused on the relationship between the conception of spatial conformations designed, or measured, the expressive forms of figuration drawn from art and graphic design, meant as interpretations with specific and distinctive knowledge values (Fig. 2).

As said, the relationship between architecture and its representation is a theme of recurring interest, analyzed several times, changing also with regard to insights in our research: we have promoted analysis facing the more strictly conceptual meanings, anchored to the evident difficulty contained in this process; other times we have studied the theoretical foundations of the representation methods, other investigations have been devoted to operational practices, or to conventions dictated by standardization requirements or the conditions of production induced by the

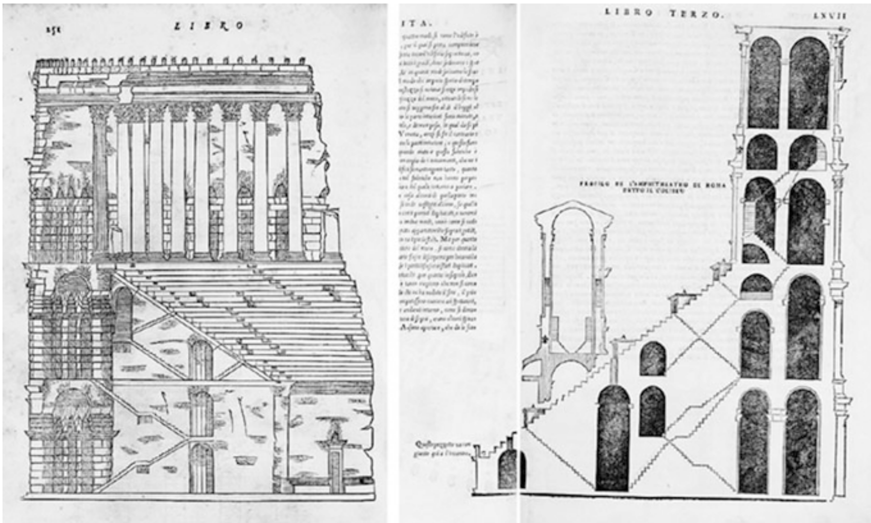

Fig. 2 The classics theaters and amphitheaters are studied by many treatises; their complexity is recorded in the graphical representations to complement the descriptive analysis contained in the texts. The articulation of space, arising from multiple functional and formal requirements, inspires distinct expressive configurations that are also reflected in the appearances and drawing techniques. Illustrations taken from the translation and commentary to the Vitruvius treatise, edited by Daniele Barbaro, for the Venetian edition of 1567, and from the Third Book of Sebastiano Serlio (edition of 1544)

technological context; more often the different aspects have been investigated according integrated attentions with various speculative contents.

During the seminar, the mediating function of Representation and Drawing and linked to the problematic connection between *knowledge and communication* was the key concept that marked proposals considerations and widely discussed with the graduate students.[1] Moreover, the challenge to narrow the discussion to the two temporal areas very far between characterized by distinct cultural connotations seemed to be a good excuse to propose a closer thinking on the effects in the graphical representation by the various statutes purpose of its use and the related production methods. The analogy between the invention of printing, which has revolutionized the ways and size of the transmission of knowledge and the current spread of digital methodologies, (today indispensable supports even in major activities and project in architectural and construction sector) has fostered lively responses by doctoral students accentuating some aspects of this comparison, only apparently risky (Fig. 3).

[1]The suggestion was developed by the student Davide Mezzino in his final report to the course: he drew a quick historical overview, starting from the *perspectiva naturalis,* about *The use three-dimensional representation in architecture: from the design idea to project management.*

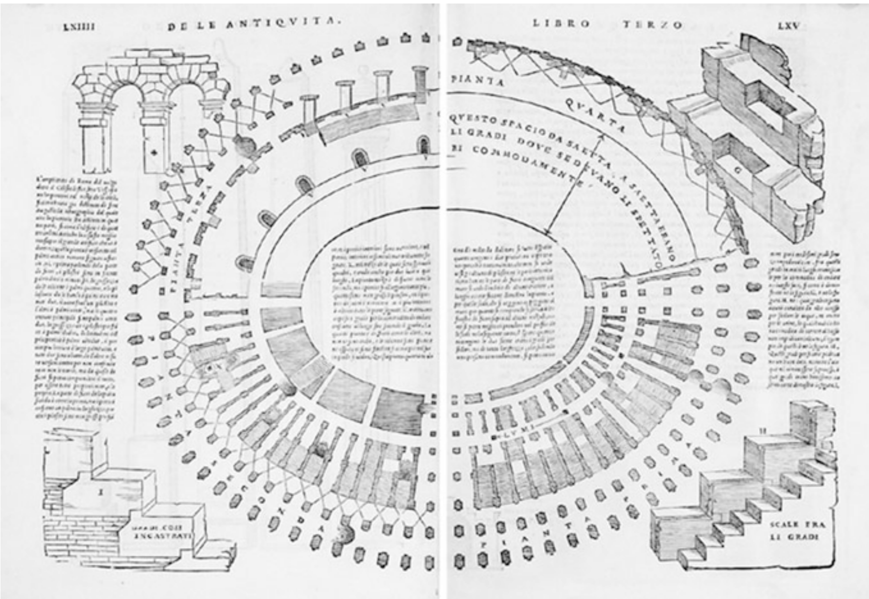

Fig. 3 A number of representative devices summarized in this composition, written for the Colosseum, indications of distributive value, static, compositional, treated in different scales. Overturning operations allow you to read spatial configurations of paths, vaults, openings, light wells, reported on four levels of representation of the plan; the pseudo-isometric views of some details show functional, structural constructive solutions: for example the water draining marked on the steps (to the *right*) and the shapes of the joints (*left bottom*). From the Third Book of Sebastiano Serlio Bolognese, LXIIII and LXV boards, printed on two facing pages, edition of 1544

3 Bridging the Gap Between Architectural Space and Representative Interpretations (GN)

As known, the three-dimensionality of the architectural space, described in Italian architectural Treaties of the fifteenth and sixteenth centuries[2] it is firstly revealed through analytical descriptions of mainly written works[3] but was soon enhanced

[2]L.B. Alberti printed his *De re aedificatoria* in 1452 (in 1550, the vernacular version of Cosimo Bartoli), Filarete is the first to draw up a vernacular architectural Treaty between 1461 and 1464; Francesco di Giorgio Martini in 1480 writes *Trattato di architettura civile e militare*; Sebastiano Serlio published since 1537 *the Seven Books of architecture*; in 1562 Jacopo Barozzi da Vignola published *la Regola delli cinque ordini dell'architettura*; in 1570 there were printed I quattro libri di architettura by Andrea Palladio and in 1615 *L'idea dell'architettura universale* byVincenzo Scamozzi, began in 1591.

[3]The lack of illustrations in the original version of the *De* re aedificatoria in dieci libri by Leon Battista Alberti, written between 1443 and 1452 and printed in 1485, joins this treaty to the *De Architectura* of Vitruvius, but between the two authors exist over fourteen centuries: the Alberti

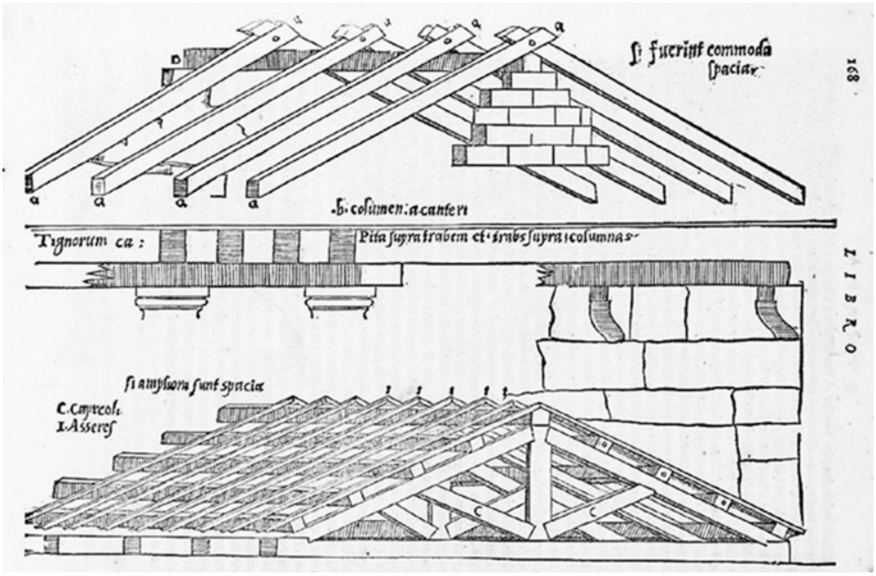

Fig. 4 The wooden support structures for roofing solutions for small and large areas are outlined in a spatial representation designed so as not to affect too much the geometrical configuration of the main trusses; to maintain accessible the visibility the other parts are only hinted at, and the lines of the design interrupted. Picture on page 168 of the Fourth Book, Venetian edition of 1567 of the translation of the Ten Books on Architecture of M. Vitruvius of Daniele Barbaro, with commented and added illustrations

with graphical interpretations that become increasingly adoperate the authors of the texts (not always coinciding with the authors of illustrations) with expressive and very different outcomes quality depending on who designs and production techniques. Although essentially it is derived from quite different conception-making processes, those representations, mutatis mutandis, seem figures not so different from some views present in contemporary architectural publications; discovering apparent and substantial differences similarities was a good field of investigation for course participants (Fig. 4).

In the various Renaissance treaties drawings and representations, more or less sophisticated in the treatment of surfaces and volumes to better simulate the three-dimensionality of space, (plans, elevations, sections, perspectives, pseudo axonometries) are the visual medium through which display concepts of compliance with static, functional and aesthetic construction requirements. The components that are more widely and in detail analyzed in the texts where they emphasize the complexity and compliance ideational through comparative comparison of

(Footnote 3 continued)

vision entrusted to only the textual description will soon be overcome, thanks also to developments in printing techniques.

mutual relations. Examples devoted to architecture and architectural details are emblematic, often recurrent and anchored to the discovery and study of models of classicism, derived from the survey of the monuments of the past, observed and drawn through the canons of geometric shapes, proportions and combinations offered by the dimensional variations of modules: graphic transcriptions make manifest the changes of the figurative uses and theories set out by different authors about the making of architecture, becoming modeling intermediaries of the project,[4] creating a theater, educational and didactic, dedicated to supporting new inspiration. This relationship, often renewed, the awareness expressed by Raffaello Sanzio,[5] in the Letter to Leo X in 1519; it is clear the purpose and reasons for the graphic representation as a fundamental instrument for the protection (we could say ante-litteram) of the classical heritage entrusted to him as prefect of antiquities.[6] Regarding the drawing he explains the pope that "[…] *el modo di dissegnar che più si appartiene all'architetto è differente da quel del pictore, dirò qual mi pare conveniente per intendere tutte le misure e sapere trovare tutti li membri delli edifici senza errore.*[…]" e ancora che "[…] *e quel spazio, bench'egli fosse in monte, bisogna ridurlo in piano* […]" Raffaello follows the Vitruvian tradition and the lesson of Piero della Francesca, distinguishing intentions and objectives of architecture drawing dedicated to the survey of those assets, it tends to enhance the shapes of a modern concept that can represent the space of architectural constructions by reading two-dimensional complementary visions[7] related them in a system. Today we would say that is confident in the wise analog abstraction of drawing that, under certain conditions, can produce excellent results with cognitive and also very practical effects. Raffaello seems to implicitly evaluate the potential and limits of graphic figuration when qualifying attributes of architectural design from painting presenting; according to this assumption, considerations on the relationship between *artifact and representation* with thoughts on the relationship between *architectural space* and *plan* drawings, including overall design and detail; at the same time it is so careful to emphasize the need to work without error, with the right measures, so as to dwell with detailed descriptions on the instruments he

[4]Interesting concept that Jacques Guillerme expressed in the Commentary to the title of his book *La figuration graphique en architecture* (1981).

[5]In 1515, Raphael was appointed prefect of the antiquities of Rome by Pope Leo X (Giovanni di Lorenzo de 'Medici).

[6]*Essendomi adunque comandato da Vostra Santità ch'io ponga in disegno Roma antica, quanto conoscere si può per quello che oggidì si vede […] ho usato ogni diligenza a me possibile, accioché l'animo di Vostra Santità resti senza confusione ben satisfatto. […]resta ch'io dica il modo che ho tenuto in misurarli e disegnarli, acciocché Vostra Santità sappia s'io averò operato l'uno e l'altro senza errore, e perché conosca che nella descrizione che seguirà non mi sono governato a caso e per la pratica, ma con vera ragione. […] Con questo adunque misureremo ogni sorte di edificio, di che forma sia, o tondo o quadro o con istrani angoli e svoglimenti quanto dir si possa.*

[7]The bibliography on Raphael's letter to Leo X is very rich; I refer to the dense article by Di Teodoro (2002), which completes and deepens with a detailed critical reading an already extensive literature.

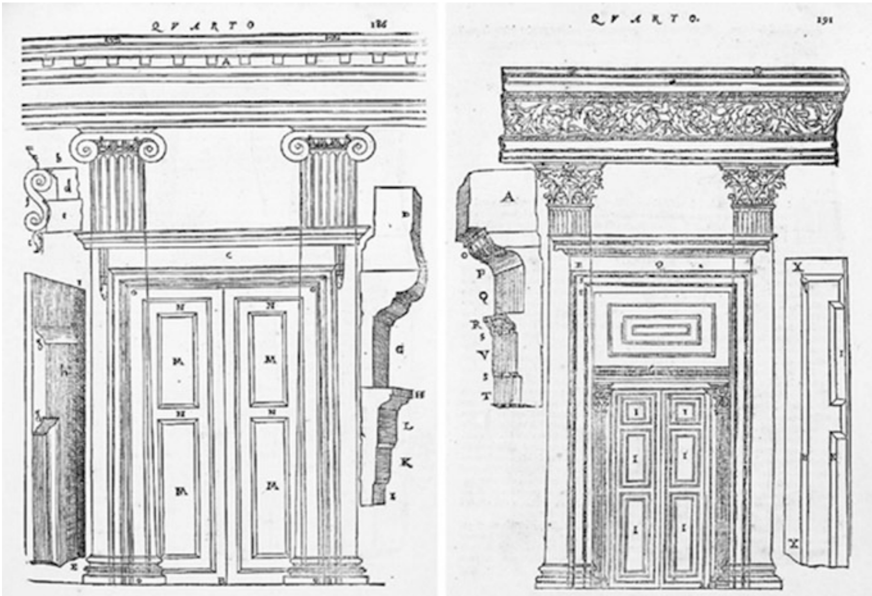

Fig. 5 An overlap of plans elevations and a group of drawing details represented in views that allow you to simulate the three-dimensional shapes, allow to appreciate the spatiality for two doors (Ionic and Corinthian ones). The columns are made transparent to assist the perception of the parties into the background, making a selection of the vision already well proven in other illustrations of this Treaty (cf. Figure on page 126, Third Book). Fourth Book, pages 186 and 191 of Daniele Barbaro volume, op.cit

intends to use in survey operations, thereby recognizing the need to keep tabs on qualitative and quantitative aspects (Fig. 5).

The ideas briefly explained to the pope by Raffaello, expendable for an operation that is cultural and operating together, are a paradigmatic example of other intellectual and practical attention that several authors of treatises on architecture introduce. From 1452 by Leon Battista Alberti, and then Antonio Averulino named Filarete, Francesco di Giorgio Martini, Sebastiano Serlio, Jacopo Barozzi da Vignola, Andrea Palladio, write anchored treated inspired by the Vitruvian mark, until Vincenzo Scamozzi who publishes *L'idea dell'architettura universale* (1615): it is a systematic and extensive compendium where architecture is presented as science. They draw up texts and, after the powerful theoretical abstraction made by Alberti, bother to explain concepts and interpret ideas using very characterized and peculiar illustrations and designs that deserve more detailed comparative exhibition; I leave to some figures, selected from those discussed with the graduate students, and here suggested as a parallel path to these brief notes, the task of demonstrating "for evidence" the theoretical concepts stated. I intended to use two main sources: the vulgar version of Vitruvius made and commented by Daniele Barbaro

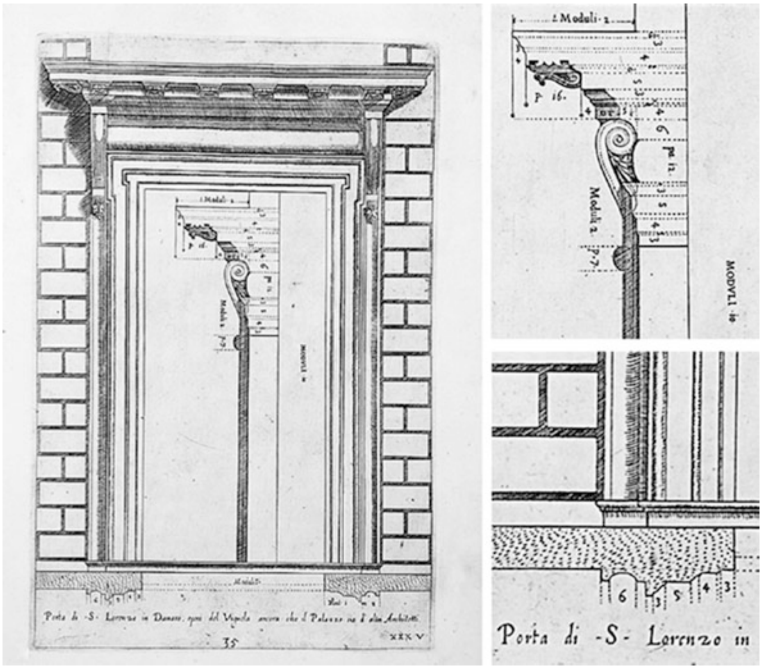

Fig. 6 Giacomo Barozzi da Vignola, in the drawing for the Porta di San Lorenzo in Damaso a Roma, uses spatial rendering of its architectural idea of shadows for the elevation and he associates to the horizontal section, treated with scanning modules, with a side view where overlaps elements belonging to different floors using hidden lines, and hatches. Table XXXV. Taken from the Roman edition of Fausto Amidei edited in 1754, while the princeps edition was edited in 1562

(1567)[8]—accompanied by many drawings, some attributed to Andrea Palladio—and the Third Book of Sebastiano Serlio (1544) on the antiquity of Rome, in the part dedicated to the theaters, for the inherent difficulty of representation that this product has (Fig. 6).

4 A Bridge to the Past: A Bold Comparison with Modern Digital Methods (GN-MLT)

The advanced comparison with current digital modeling, exploited today in the design process, wants to emphasize that behind the appearance of similar figures there is an overall representation of the production process, resulting from the

[8]The first edition was in 1556, while the one from which I drew the images used in support of the contribution is published in Venice in 1567 by Francesco De Franceschi.

Fig. 7 Section, elevations and conceptual views, construction details and render of the main entrance to the new Carlina hotel, in Turin. The digital model is simultaneously used to operate functional, stylistic and material/color choices. *Image courtesy* architect. F. De Giuli (2015)

management of geometrical data somewhat different: previously the three dimensional configuration was the completion of different representations; thanks to these new computing methodologies the three-dimensional modeling, shaped or rebuilt in the digital environment, is the source from which drawings are generated, where graphic and alphanumeric contents are enhanced; the model are not only associated to the geometrical properties (Ackerman 2003): many other attributes and relationships can be registered in a storage space (database) which can be edited, implemented and consulted to be concretely shared in a collaborative work environment. Centuries later the designer and revealer's responsibilities are not in question: this topic still remains central and maintains a non-transferable function to any technological system, even the most advanced. But those shape simulation apparatus, designed for prefigurative purpose function (project) or morphological restitution (survey) become representations that also temporally extend their role, being able to enlarge its function of cognitive support to the entire period of lifecycle management (Fig. 7).

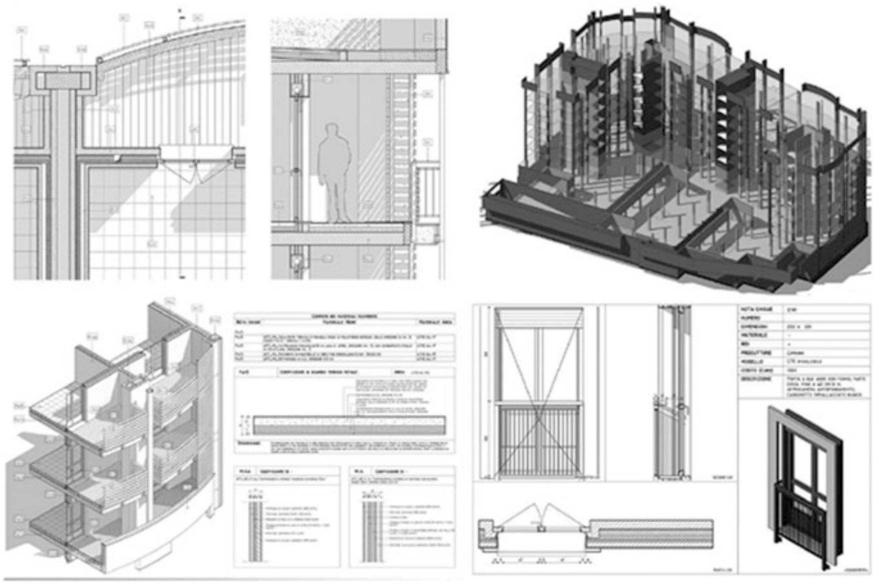

Fig. 8 Orthogonal projections, spatial views, and detail views of the same portion of a building. Construction of 78 residential accommodation for ATC on Spina 4, in Turin. Source: Alberti, Alessio. 2014. The infographic evolution of the construction process: from the integrated design environment for the construction site management 4D and 5D. Master Thesis in Architecture-Construction and City degree. Lecturer: prof. M. Lo Turco, Politecnico di Torino

Referring to past Masters it seems interesting to be compare the surplus value provided by new digital tools that recover multidisciplinary knowledge, with Brunelleschi's design process and the inextricable relationship between his theoretical research, together with the material act of "working with the others". In fact, he paused to discuss technical details with the artisans, managing their contracts, made sketches with the masons; he had efficient collaborators such as Arnolfo di Cambio and Antonio Manetti, but above all he knew that imagination was not enough: the dream had meet a methodology that would make it feasible, in the knowledge that the architect was the person able to conceived the design and the realization process as the two sides of the same coin. Timeless setting that is in line with the collaborative approach so chased and proposed recently by new digital platforms (Fig. 8).

In contemporary practice it is the model, as a dynamic information system, to become multi-dimensional, operational tool which collects information increasingly dense, able to offer support to give solutions to instances of static-structural, functional check correspondences and suggest alternatives for spatial conformations also in terms of their aesthetic value. Simultaneously, through the same data asset, you can also improve the communication effectiveness of the three-dimensional modeling through photorealistic representations, giving the appearance of reality even in dynamic modes, very useful for verification and control operations and for

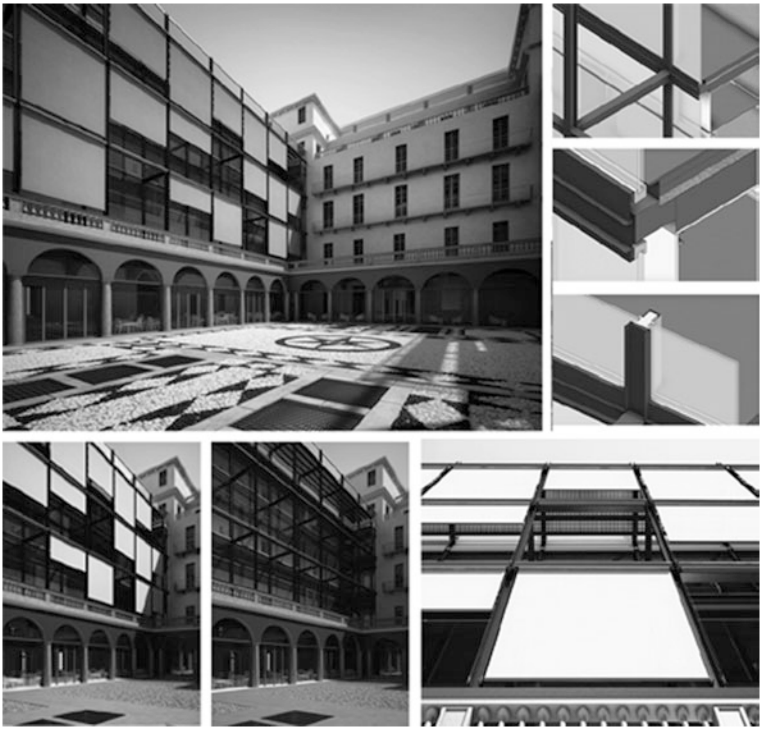

Fig. 9 Overall views, cross section axonometric and construction details resulting from a unique three-dimensional model, able to compare different solutions of darkening changing time and the construction technology parameters. The virtual model simultaneously provides quantitative data on the energy balance of the different building façades. Renovation of the Carlina hotel, in Turin. *Image courtesy* architect. F. De Giuli (2015)

dialogue with wider public with limited technical skills: the simplification of the digital processing of information—both for acquisition and for restitution, representation and modeling procedures—are now a shared heritage and practiced by a large host of users, changing the traditional operational boundaries. In this context, Representation takes part as a dynamic agent, stimulates action and collects instances, works to produce ideas that, responsibly, must be reviewed and verified by multiple controls that, to better perform, claiming a greater quality and quantity of information which may depend on the success of the interventions, the success of the works and of their useful life: it therefore claims an increasingly strong cognitive value as an active medium throughout the investigation process, since its inception, in harmony with the modus operandi advanced by Brunelleschi.

Representing therefore consists in a selected recording of those elements that constitute the essence of identity object (measured or designed) and the relationships involved in the system between its components (Santagati 2016). The goals seems to be in harmony with common objectives, and sometimes absolved from

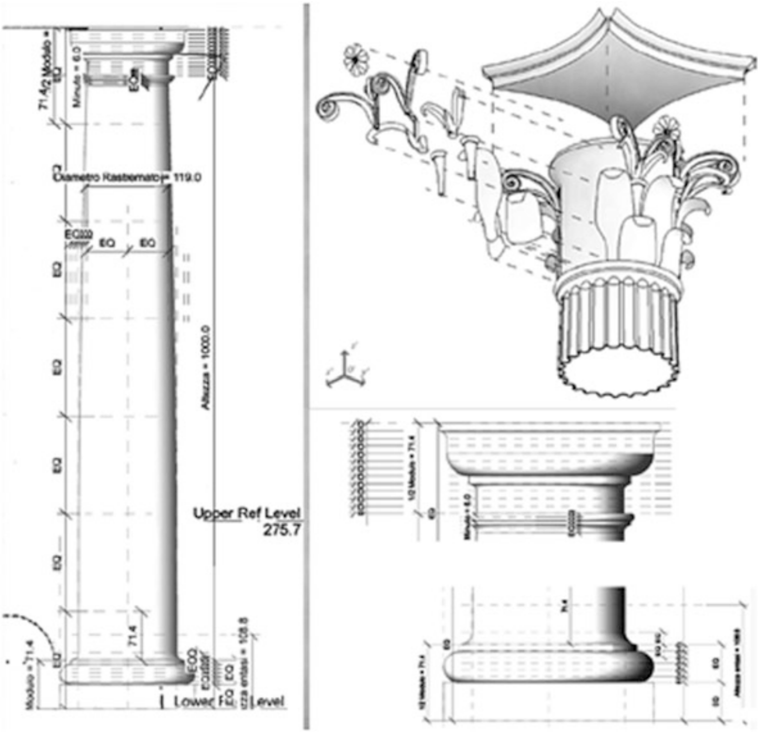

Fig. 10 The Tuscan order of Vignola revisited in parametric key, using the rule of successive partitions, through a relationship and constraints between parts. At right on the *top*, an exploded axonometry obtained by decomposition of the decorations of a Corinthian capital digitally processed; on *bottom*, virtual modeling of Tuscan base and capital of Vignola (Authors: M. Lo Turco, P. Aubin)

classic textural models adopted to overcome the inherent difficulties presented by the interpretation of drawings, both with regard to the understanding of the representation codes and with regard to the way of converting the real space-time unit with its discretized representation (Fig. 9).

5 Conclusions (GN-MLT)

Forms useful to invention and architectural memory, reinterpreted through the proposed documentary traces are endless. The suggested comparison aims to bridge the gap between architectural space and representative interpretations and appears only one of the issues that the architectural drawing helps to explore. The multiple uses of graphic representation determined educational standards, technical practice, more or less collaborating with artistic doctrines and aesthetic judgments, areas that this contribution has failed to enunciate in a complete way, as it appears difficult to assign limits to architectural representation (Guillerme 2012). However we believe that is important to stress that return of interest on similar issues can be considered as a scientific responsibility that deserves perform, presenting to the attention of younger people the successful cultural renewal season that the Renaissance treatises triggered with regard to architectural design and that the informatic revolution seems almost favoring resubmit new expectations. Critically evaluate these expectations means necessary to put them in a comparison on forms of mediation useful for project management. Research on architectural drawing, if critically directed, are a fertile field of reflection for those who are being formed on the Cultural Heritage, and the results achieved can be of some help to improve decision-making processes with positive implications and directions to propose the most effective and meditate actions on the architectural and landscape heritage (Fig. 10).

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Author Biographies

Giuseppa (Pina) Novello Born in Regio Calabria in 1950, graduated in Civil Engineer at the Politecnico di Torino in 1973, where since 2000 she's a full professor of Disegno e Tecniche di Rappresentazione (drawing and representation techniques). She pursues the educational activity for Ingegneria per l'Ambiente e il Territorio (engineering for environment and territory), Ingegneria Edile (construction engineering) and Ingegneria Civile (civil engineering) studies. Involved in teaching and tutoring activities in Ph.D. courses, she's been part of the Ph.D. board in Beni Architettonici e Paesaggistici (architectural and environmental heritage). Member (2012–2015) of the TechnicalScientific Committee (2012–2015) for the UID (Italian Drawing Union), she has curated in 2015, with Anna Marotta, for the UID the annual congress and the international meeting Disegno&Città (drawing and the city). The research activity she has started in 1973, at the

Istituto di Architettura Tecnica (technical architecture school), and later at the Dipartimento di Ingegneria dei Sistemi Edilizi e Territoriali (construction and territory systems' engineering department), she keeps working at the Dipartimento di Ingegneria Strutturale, Edile e Geotecnica (structural, building and geotechnical engineering department). She has studied and edited on cities, infrastructures, environment and territories' representation, with constant interest towards the relationship between the knowledge of media's role in scientific communication, in education and technical practice, dedicating speculative studies to the application of computer technologies for project and survey. Member of the Associazione di Storia dell'Ingegneria Italiana (ASI—Italian History of Engineering association), she has led several researches on the history of the polytechnic and on drawing's role in graphic representation in engineering schools.

Massimiliano Lo Turco (1977) Engineer and Architect, he was awarded a research doctorate in Disegno e Rilievo per la tutela del patrimonio edilizio e territoriale (drawing and surveying for the conservation of building and territorial heritage) at the Politecnico di Torino in 2007. Since 2015 he is Associate Professor (L.240) for Area: 08 / E1, Sector ICAR / 17 –Drawing, in the Architecture and Design Department at the Politecnico di Torino–, where he conducts researches in the field of parametric design and digital modeling in architecture. In 2001 he was Scientific Coordinator of the research project named "Green Building Information Modeling: parametrici tridimensionali modelli per la progettazione sostenibile in field edilizio (Green Building Information Modeling: three-dimensional parametric models for sustainable design in construction field)". Scientific Responsible prof. G. Garzino. (Research funded by the Cassa di Risparmio di Torino). The results of the research were published in the book GARZINO, Giorgio (edited by) 2011. *Drawing (and) information. Polytechnic drawing,* Maggioli Editore. Santarcangelo di Romagna. In 2015 he publishes the book *BIM and infographic representation in the construction process. A decade of research and applications*. Arachne. Ariccia.

Geometrical Methods for the Cross Vault Ribs Profiles Layout. The *Lonja de Valencia* Chapel

Esther Capilla Tamborero

Abstract The ribs profiles of the cross vaults were molded using templates or patterns, made of wood or metal, in order to facilitate the master mason task, so they can execute properly the arch stones that would be part of these ribs. They were performed according to a geometric method evolved over time. Here we show the geometric method hypothesis used to construct some ribs profiles pertaining to some cross vault of La Lonja de la Seda, a representative valencian building located at the city of Valencia, which is world heritage since 1996.

Keywords Templates · Geometric methods · Cross vaults

Templates or patterns, such as Bechman (1991, 48) said, were made in order to facilitate the task of the master mason so they can execute correctly a voussoir, a springer or a key. The templates, executed in wood or metal, represented the different faces of the stone and the stonemason only had to reproduce them.

Villard de Honnecourt in his *Alb*um includes some "templates" defined by Erlande-Brandenburg (1991, 24) as "scantlings of wood provided by the architect to the stonemason in order to perform the different moldings." Also, the author remarks that "already in the second half of the 12th century an evidence of this system of work is found yet in Guillaume de Sens work, in the Canterbury's factory", moreover, "the scantlings were jealously preserved throughout the factory activity in order to assure the cohesion of all moldings of the monument, from the placement of the first stone, because it was known in advance that its construction would be long, due to funding difficulties." (Erlande-Brandenburg 1991, 24) (Fig. 1).

Eugène Viollet-le-Duc (1814–1879) in the term *Profil* (Profile), included in Volume 7 of the *Dictionnaire raisonné de l'architecture française du XI^{e} au XVI^{e} siècle,* wrote 50 pages about the profiles. This text defines the meaning of the *profile*

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https://doi.org/10.1007/978-3-319-58856-8_133

Fig. 1 Folio 32 detail of Villard de Honnecourt's *Album,* with drawings of details of the stones cutting pattern for Reims's Cathedral. In the image, according to the caption: "Here are the templates of this page chapels, those of the vain ones and windows, of the ogives, of the transverse ribs, and above, the formers." (Villar de Honnecourt. [13th Century] 1991, plate 63, p. 138 translation)

concept in architecture as a section done over a molding. Furthermore, the author specifies that a profile is a vertical section or a normal section to the curve of an arch, but remarks that this term is not applicable to the horizontal section of a pillar because pillars are horizontal sections, not profiles. It also refers to the templates or patterns ("molle") (Viollet-le-Duc 1854–1868, 7: 483).

Viollet gives a great importance to the study of profiles, on having considered it to be necessary for: "1st recognize the principles that have governed the various architectural styles; 2nd, to classify those styles and confirm the date of the monuments". This importance that Viollet gave to the profiles is magnified when she affirmed: "The profile, it is the architecture" (Viollet-le-Duc 1854–1868, 7: 484).

Among the numerous architects talking about the importance of the templates we can cite Philipp (1995, 346), who describes that in the construction of Gand's Town hall, templates were "the key" to sustain the organization of work division. He reaffirms that importance when he says that "the templates were intellectual property of masters who created them, since it is testified by Hermann Tom Ring's supposed portrait (about 1540) (Fig. 2), in which the templates hanging on the wall are the attribute of his activity as an architect." Also, it considered the fact that the stonemasons could be sanctioned because of them: "The ordinances of Gand's workshop, preserved since 1528, sanctioned severely the stonemasons who leave the template on the stone that they are working on or trampled underfoot. The sanction was doubled if the template was broken." (Philipp 1995, 346).

In the Valencian area, several authors refer to the use of templates. Sanchis Sivera (1933, 16–19) mentions the payment for carving templates that appear in some clauses of the capitulations signed by Jaime Esteve for the construction of the Valencia's Cathedral retrochoir, in 1415.[1] In some clause of the above mentioned

[1] SANCHIS SIVERA, José. 1933. "Arquitectos y escultores de la Catedral de Valencia". *Archivo de Arte Valenciano,* XIII. 16-19. Mentioned in Navarro Fajardo (2004, 35).

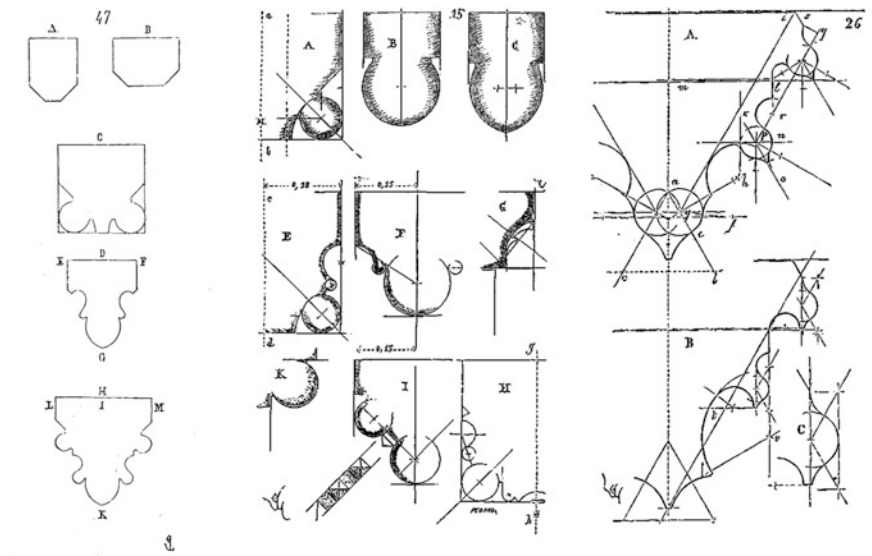
Fig. 2 Ludger Tom Ring der Ältere, *Portrait of an architect.* Berlin, Preussischer Kulturbesitz, Staatliche Museen. Germäldegalerie. The templates are shown behind the architect (From Jan Philipp 1991, 325; in Cassanelli, comp.)

capitulations are made explicit “the term of execution, the salary, and the payment for carving ‘motles’” (templates).

1 Viollet-le-Duc’s Geometrical Method for the Profiles Layout and Its Evolution in French Architecture

As we have mentioned, Viollet-le-Duc, in the term *Profil* of the *Dicctionaire raisonné,* speaks extensively about the profiles, both external (cornices, capitals…) and interiors. Here we refer only to the arches of the vaults. Viollet develops a geometric method for the layout of the same ones to which we will do a brief allusion. In the term *Construction*, on having spoken about the vaults, she does a generic description on the evolution of ribs profile that captures in the sheet 47 of that term (Fig. 3, left) (Viollet-le-Duc [1854–1868] 1996, 85).

The tour for the profiles’s geometric method was initiated by Viollet with the vaults of the Saint-Denis’s abbey church, where the Abbot Suger between 1140 and 1145 performs significant transformations by replacing the barrel vaults or roman edges by vaults of ogival or cruises arches, with wall-archs, transverse and diagonal arches (Fig. 3, middle image). Viollet (1854–1868, 7: 505–507) explains that the architect of Saint-Denis, yet close to the Romanesque forms, gives the ogival arch



Ribs' profiles evolution according Viollet-le-Duc. Figure 47 of the term *Construction*. (Viollet-le-Duc [1854-1868] 1996, 85)

Profiles of the Saint-Denis' abbey church (1140-1145) (A, B y C) and the Vézélay's chapter houses (around 1140) (Profiles E, F, G, H, I, K). Figure 15 of the term Profil. (Viollet-le-Duc 1854-1868,7:ilust. 15).

Profiles of the Eu's church choir; first half of the 15th century. Figure 26 of the term *Profil*. (Viollet-le-Duc 1854-1868, 7:ilust. 26).

Fig. 3 Profiles according Viollet-le-Duc gathered in the terms *Construction* and *Profil* of the *Dictionnaire raisonné profil de l'architecture française du XIe au XVIe siècle*

another profile that the transverse arch and the wall-arch; however it adopts what he calls *boudin*. The *boudin* is the cylindrical bull to draw both arches, but acknowledges that the ogival arch, composed of a large boudin is weighed, and seems to offer more resistance than the transverse arch having two boudins of a low diameter taken between both edges of soffit. A few years later, around 1165, the architect of Paris's Cathedral adopts the consequences of admitted method. The section of transverse, ogival and wall-arch it submits them to the only system of profiles with slight differences in it.

Viollet incorporates diverse examples of the 13th century in which makes claims to have an evolution from a reasoned feeling towards a geometric tracing method based on lines of 45º, 60º or 30º. He gathers, likewise, examples of the 14th and 15th century (Fig. 3, right) where the geometric method is also based on those angles.

2 The Profiles Evolution of the Ribs in the Spanish Gothic Vaults

Viollet-le-Duc (1854–1868, 7: 505–509) said "no part of the architecture is more appropriate to show the schools differences that the profiles (…)". Lampérez (1930, 488), talking about Spanish architecture, tells that "profile art in the cross vaults ribs is enough to characterize them, according to the development times and schools". He supports, as well, that in transition periods the transverse arches have different profile that the diagonals, being this one a generic character of the vaults built at the last third of the 12th century and first of the 13th, which after a parenthesis characterized by profiles unification during 13th and 14th century, comes back imposed at 15th century with complicate nervures with secondary arches and tierceron ribs. Lampérez (1930, 490–491) also describes an evolution of profiles at late 12th century and early 13th century, which answer to a section of rectangular contour with ramrods and gorgets, and go coming closer towards forms inscribed in triangles by means of ramrods which are finished off by filets, up to eliminate the ramrods in the second half of the 15th century and 16th first "(…) and the profile comes into a monotonous, dry and without contrast thing".

Templates of the Valencian cross vaults can be typify in four large groups gathered by Navarro Fajardo (2004, 14): Romanesque tradition mouldings used mainly in the 13th century; concave-convex triangular trace mouldings, used in the 14th and 15th centuries, differentiated into two types, ramrod head and sharp end; gimped ribs used in the late 15th century and "al romano" moulding templates employed since the 16th century.

Here we add profile drawings of some ribs of the vault that covers the chapel adjoining to the columned hall of the *Valencia's Lonja*—built at the end of the 15th century—, as well as a geometric methods hypothesis that master stonemasons implement for making templates with the voussoirs of these ribs were made. These methods are studied in greater depth and a greater number of profiles in the doctoral thesis of the authoress of this article, entitled *Geometry, art and construction. The vaults of the 13th to 16th century in the Valencian environment.*[2]

The aforementioned doctoral thesis deals with research of the Valencian cross vaults around the geometrical and constructive conception of them, noting that not understood the construction of these vaults without geometry and all understood as an art. Numerous authors speak of the importance of geometry in the Middle Ages. Villard de Honnecourt in his *Album* of drawings of the 13th century repeatedly writes "geometry art"; Viollet-le-Duc in the term *Construction* of his Dictionnaire Raisonné said in the 19th century "construction is a science; but also an art"; Father Tosca in his *Tratado de la montea y cortes de cantería,* edited in the early 18th century named Arts, both architecture and stonework. Numerous ancient documents such as mentions Ruiz de la Rosa (1987, 266)—who gathers Ghyca (1968, 62)—concerning an ordinance of 1397, found and studied by Reichensperger, shows that for the stonemason "geometry was properly fundamental science". Many other examples could mention that affect the same idea but we already show the geometric methods of the above profiles.

[2]Being directors, professors Rafael Soler Verdú and Juan Carlos Navarro Fajardo. Read on February 10, 2016.

3 Geometric Method for the Ribs Profiles Layout of the *Lonja de Valencia* Chapel Vault

Valencia's *Lonja de la Seda*, considered one of the Spanish civil Gothic best examples, was declared a World Heritage year 1996. Also known as *Lonja de los Mercaderes* or *Casa de contratación*, was built in the late 15th century, between 1482 and 1498. On January 12, 1481 Pere Compte and Joan Yvarra were chosen "mestres" of the work of *La Lonja*, according to a document from the "*Manual de Concells*" gathered in Aldana (1988, 2:15). Also it mentions Aldana (1988, 1:57), besides the gangs or "companyas" of Pere Compte and Joan Yvarra, a third, which Alfonso of Leó was at the head of.

Valencia's Lonja has two lodges: one in wich the *sala de contratación* o *salón columnario (*columned hall) is situated, and another where the ancient *Sea consulate* is located. Both bodies are organized around a garden and articulated through a tower whose ground floor is located the old *Lonja chapel,* dedicated to the Conception virgin.

In February, 1486 starts the construction of the chapel vault (Ramírez 1999, 80). It is a starry vault with 9 keys, composed by wall-arch, diagonal, tercieron, ligature and rampant ribs; realized with three different profile types: the wall-arch profile, the diagonals and the common one to tiercerons, ligatures and rampants profiles. Here we present process hypothesis of the wall-arch geometric method and the complete tracing of other two types.

It's no necessary to say geometry is the basis geometric methods. The elementary geometric forms employed are the triangle, square, rectangle and circle as fundamental basis for generation of the others. The employment of these forms is referred by Gentil (2008, 14): "there still earlier cultures only existed the Greek geometry, to historically very recent times, (…) which the Middle Ages only provided some practical geometric constructions. (…) Greek geometry was a lacking science of algebra for his application, with a very limited arithmetic and that covered, for practical purposes, that could be resolved by the ruler and the compass. Thus, initially, the employed forms had to be the simplest –circle, square, triangle and rectangle– to which later added are other polygons from the bisection of angle; it is to say, hexagons or octagons with very few variations."

We pass to describe the geometric method hypothesis for the layout of the Lonja chapel vault wall-arch profiles.

For the determination of the wall-archs profile geometrical method hypothesis of the Lonja's chapel vault we did begun of the dimension marks token in situ by dimensioned sketch (Fig. 4) and a profile-meter (Fig. 6).

In the sketch made in situ (Fig. 4) were token the dimensions of the profile significant points and the curves were limited by coordinates using flexometers, squares, levels, metal rulers, calliper, … It is characteristic of the profile the presence of concave curves alternating with convex curves (Fig. 5), so for a more rigorous data collection were made several rubbings mouldings with profile-meter (Fig. 6) that they had to superpose.

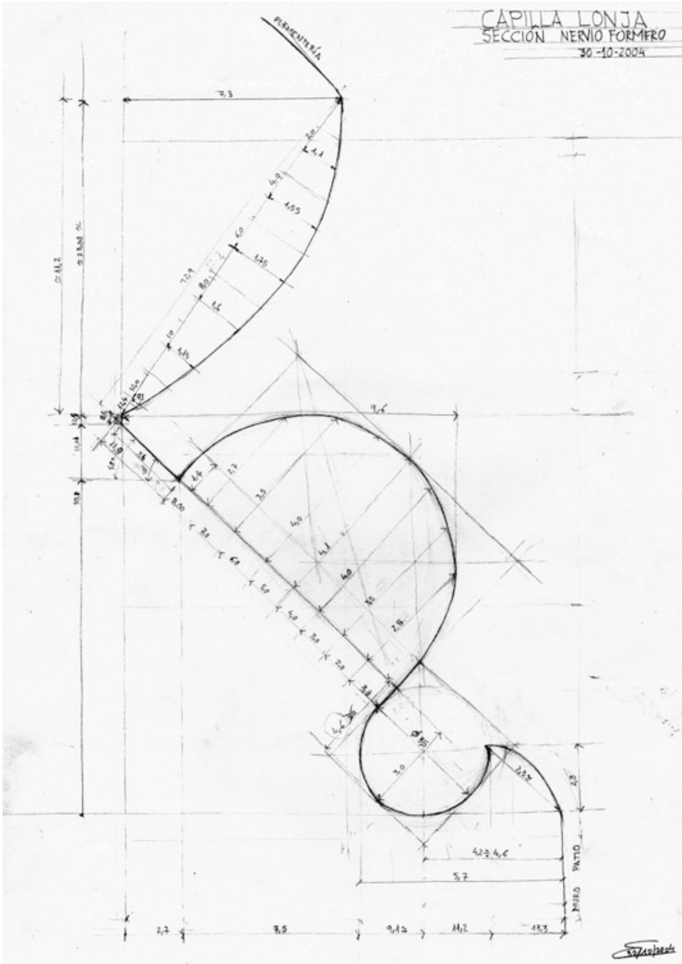


Fig. 4 Dimensioned drawing of the *Lonja's* chapel vault wall-archs profile. (Esther Capilla. 30-10-2004)

From Figs. 7, 8 and 9 it is shown, by succeeding steps, the geometric method hypothesis to determinate the profile mouldings. In the scale representation of the profile it has been observed that the layout of this one can be drawn 1 Valencian handbreadth side square (22.65 cm) (Fig. 7, left image). In step 2 (Fig. 7, central image), we can see that the only straight molding of the profile, the listel 1–2, which measures 4 cm (0.18 Valencian handbreadths) and it is centred on one of the diagonals. It will provide for moldings curves. In the right image (step 3) of Fig. 7 it can be seen how the center of the cavetto adjacent to the listel is in the same diagonal. The cavetto diameter is determinate by a parallel line to the perpendicular a diagonal line of the lower end of the listel (point 2) and a parallel line from this which crosses the vertical axis of the right lower square—from 16 in which is

Fig. 5 Above, image of the Lonja chapel vault. Below, one of the spring, observe the profile of the wall-archs with diagonals and tiercerons. (Photo: E. Capilla. 31-10-2004)

divided the general square—with 1/4 Valencian handbreadth side (point 3). The centre of the cavetto (point 4) is, then, in the median point of the 2–3 segment.

In Fig. 8 we can see how to obtain the center and diameter of the lower torus and the cavetto tangent to the wall. In the left and center images (step 4 and detail) it can be seen how the diameter of the lower torus is bounded by the diagonal where is

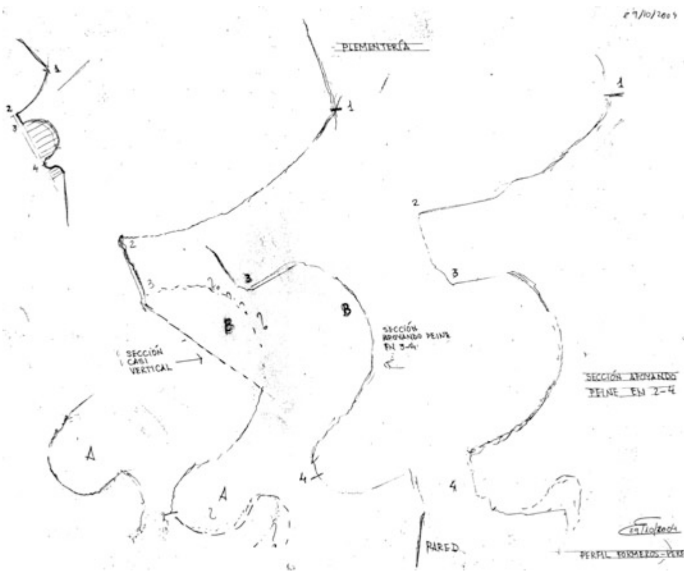


Fig. 6 Wall-arch profiles obtained by several measures by profile-meter (Esther Capilla. 29-10-2004)

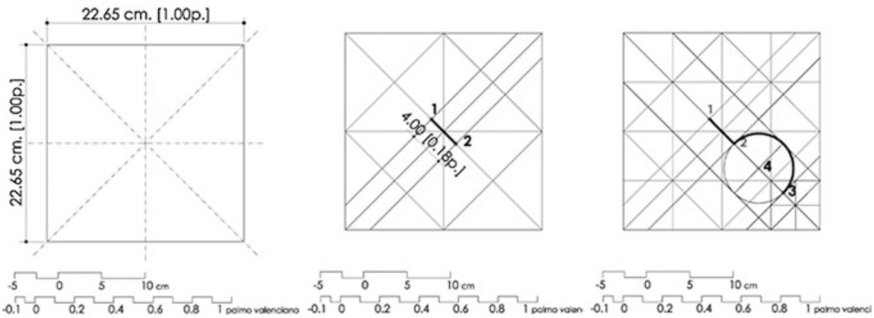


Fig. 7 Wall-archs profile geometric method hypothesis process of the *Lonja de Valencia's* chapel starry vault. Steps 1–3

situated in point 3 and the parallel diagonal of the lower square of side 1/8 of the side of the greater square. The circumference of the torus in addition to be tangent to these diagonals it is also tangent at the bottom and left sides of the small square. The center of this (point 6) is in the bisector of the angle formed by the diagonal in which is situated in point 3 and the lower side of the square. The perpendicular to the diagonals which delimits its diameter determines the points of tangency T1 and T2. The perpendicular to the bottom and left sides of the square of side 1/4,

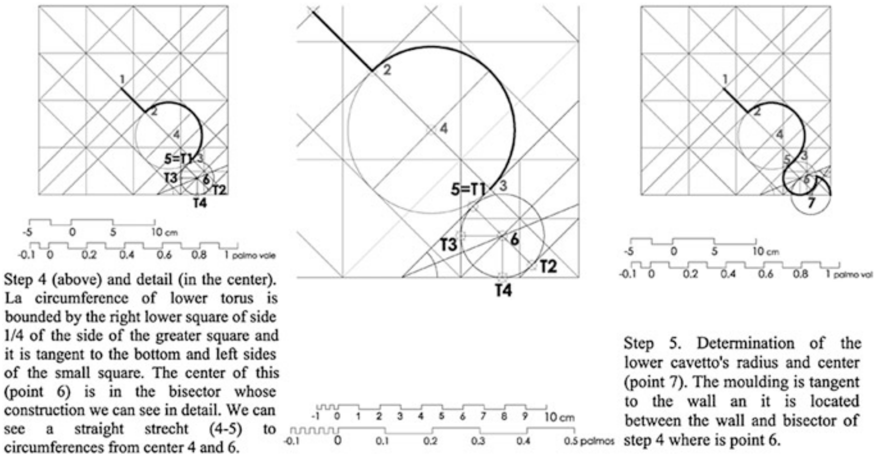


Fig. 8 Wall-archs profile geometric method hypothesis process of the *Lonja de Valencia* chapel star vault. Steps 4–5

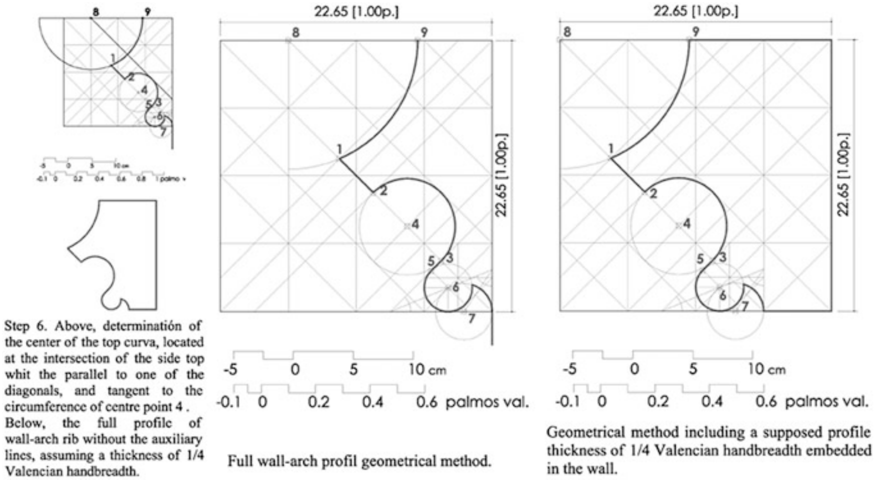


Fig. 9 Process to get wall-archs profile geometric method hypothesis of the *Lonja de Valencia* chapel star vault. Step 6 and full geometrical method

determines the points of tangency T3 and T4. T1 tangent point coincides with point 5, end of the line stretch there is between the torus and the cavetto, tangent to both curves. In the right image (step 5) can be seen how to obtain the lower cavetto[3]

[3]In various Spanish dictionaries, speaking over molding, the cavetto is defined as a concave molding whose profile is approximately a quarter circle, and include that Spanish name as synonymous with *esgucio, antequino, media caña.* Ching (1997, 15), Serra (1997, 2: 663).

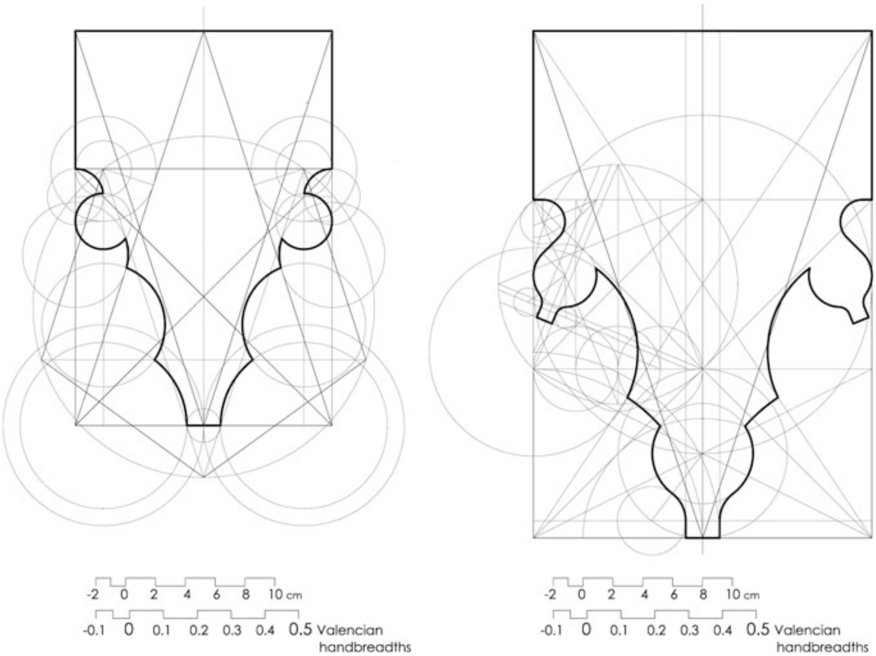


Fig. 10 Geometrical method hypothesis of tercierons, ligatures and rampants (*left*) and diagonals ribs (*right*) of the *Lonja de Valencia* chapel

radio and center (point 7), tangent to the wall. The center (point 7) is situated in the bisector of the angle formed by the bisector that has determined the center of torus (point 6) and the right side of the square, being the radius the distance between point 7 and the lower right end of the square, tangent to the wall.

The upper-left image (Fig. 9) shows the step 6 of the geometric method, which reflects the way of determining the upper inverted cavetto center (point 8), which is situated at the intersection of the square top side in where the profile has been inscribed with the tangent to the cavetto center (point 4), which also is parallel to the diagonal 1–2–3–4.

The lower-left image in Fig. 9 contains the complete profile of the wall-arch without adjuvant constructions, assuming a thickness embedded in the wall of 1/4 Valencian handbreadth. In the center and right images of Fig. 9 is included on a larger scale, the entire geometrical method hypothesis process; in central image, without the profile thickness; in the right image, adapting the square to the wall-arch profile assuming the mentioned thickness.

As we seen throughout the process, the wall-archs profile geometric method is based on 45° lines, in addition to horizontal, vertical, and bisectors. That is within Viollet-le-Duc mentioned about the evolution of the geometrical methods: the profile curves centers were placed on lines to 60°, 45° and 30° (Fig. 3).

However in other profiles studied in the doctoral thesis, the geometric method is not based on lines to 45°, 30° or 60°, but in other angles related to the rectangles dimensions in which the profiles are inscribed. As in tiercerons, ligatures and rampants profiles in the same vault (Fig. 10 left), the angle of the triangle inscribed in the rectangle to generate the geometric method is 72° and in the diagonal ribs profiles (Fig. 10 right), the angle is 71.565° related it with 2/3 proportion triangle between its base and its height, while in last one there are relationships from lines to 45º or bisectors. We defer the analysis of geometric method hypothesis of these profiles for another communication, although we include here the entire layout obtained from both profiles (Fig. 10).

4 Conclusions

We have shown some *geometrical method* hypothesis of layout that would follow the master stonemasons to carve the cross vaults ribs templates.

We have found that the geometry is the scientific basis of the profiles and that geometric methods are based on the elementary geometric figures: squares, rectangles, triangles and circles. Occasionally, pentagons.

We have seen that Viollet speaks about an evolution in the French cross vault profiles to determine the geometric method based on lines 45°, 30° and 60°. In the profiles studied here, as that wall-arches of the *Lonja de Valencia's* Chapel, the method is based on lines 45 but in others, these tracings come given not by those angles, but by the triangles which fall in the rectangle in which the profile is enclosed and other relationships derived from them.

We have stated the importance of the templates in medieval times, to the thread of what authors gather as Philipp or Viollet-le-Duc. The latter considers fundamental the profiles study to recognize the principles that have governed the diverse architectural styles, to classify and to state them the date of the monuments. Since we gather in the doctoral thesis, the profiles give us light on the authorship of vaults.

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The Future of Augmented Reality in Architecture: From Real to Virtual Heritage

Enrique Castaño Perea and Julián de la Fuente Prieto

Abstract This paper analyzes the relationship between Augmented Reality and Architecture. Firstly, connects the theoretical framework of both disciplines through the Representation concept. Secondly, describes the milestones and possibilities of A.R. in the particular field of archaeological reconstruction. And lastly, takes a critical look about their sustainability and future development.

Keywords Augmented reality · Architectural representation · Archaeological reconstruction

With the development in recent years of augmented reality and the appearance of new mobile terminals and storage bases on-line, we find the possibility of using a powerful tool for transmitting architecture. The technology is developing at high speed so it's time to make a critical reflection both from the technical point of view its use and reliability, and from their critical and professional validity approach.

The introduction of new media has always been a process of uncertainty that had to be overcome and adapting to the needs demanded by society. In the field of graphic representation, from the first gadgets that facilitated the drawing; as the window of Leonardo or the "camera obscura" that used Canaleto to draw the Piazza San Marco in Venice, they were harshly criticized by his peers for the introduction of technology. Recently, the introduction of tools for architectural representation such as render process, are enquiring the importance that supposes the representation instead the creation of architecture (Iñarra et al. 2013) (Fig. 1).

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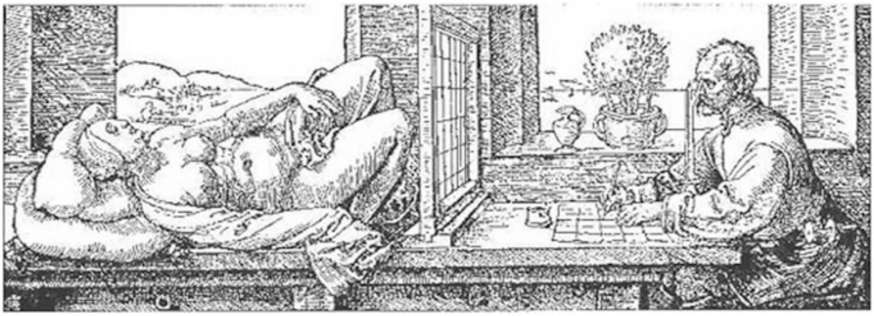

Fig. 1 Picture “Leonardo Window”

1 Virtual Reality to Augmented Reality

Computer technology has facilitated the generation of 3D images from the beginning of the first graphic interfaces. In fact, this computing power has allowed the creation of complex 3D visual environments for all kinds of applications such as video games, geographic information systems, as well as graphic, industrial and architectural design. However, these 3D Images have always needed a computer interface to be represented.

No matter about how realistic it was playing these 3D objects, always they remitted us to a Virtual Reality.

The first who was try to overcome this antithetical opposition between the “real” world and “virtual” were Milgram and Kishino (1994) by making its Continuous Real-Virtual’s model. His proposal was trying to integrate real and virtual elements in a Mixed Reality that could be experienced in continuity with both worlds (Fig. 2).

Through this paradigm, in the mid-90 s began to develop a new technology derived from real-world application of this Virtual Reality; *characterized by inserting objects or virtual space in a real scenario* (Ruiz Torres 2011: 3) It is what is now knowing as Augmented Reality and allows us to visualize 3D elements through any type of device reproducing a real image.

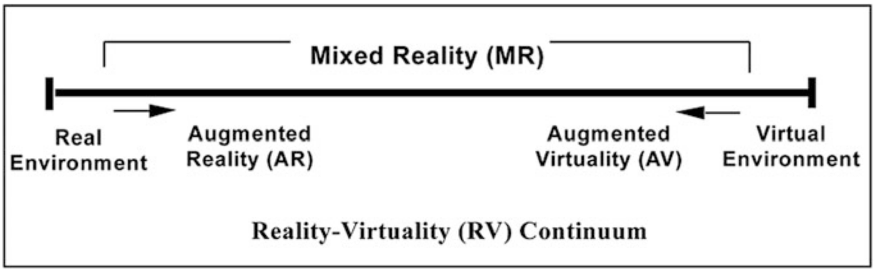

Fig. 2 “Continuo Real-Virtual” en Milgran and Kishino (1994)

This condition could be attributed to any type of assembly or photo correcting, but according Fernández Álvarez the key to this Augmented Reality is that *there is a true correspondence between the real and the virtual in terms of scale, proportion, proximity, perspective, depth, etc., which allows the user in some applications experience space full scale* (2010: 3). Therefore, we are proposing a paradigm that is not intended to recreate a new virtual world, but to create a single integrated both real space and 3D images by visual world.

2 Augmented Reality and Archaeological Reconstruction

Augmented Reality and Architecture are areas of research that converge inevitably; especially in the field of archeology. Archaeology has always needed tools to interpret and disseminate the remains found in any field while Augmented Reality is born with the desire to enrich and expand our ability to visualize the real world.

Now we reflect on these existing technologies and their ability to go together into archeology and architecture with the quality to be useful for both professionals and amateurs.

3 The Cultural Heritage and Archaeological Reconstruction

Although the legislation is decentralized for Cultural Heritage in each Autonomous Community, the law 13/1985 of Spanish Historical Heritage remains the legal document that inspires any work on an archaeological site. Its tasks makes it clear that conservation, consolidation and rehabilitation of archaeological heritage will prevent attempts at reconstruction except when original parts thereof are used and can prove its authenticity.[1] This principle has set the trend for the so-called "fossilization" of deposits, preserving the appearance of archaeological remains after excavation surface.

However, the same law heritage in its preamble states that all measures to protect and promote the Act provides only make sense if, in the end, lead to an increasing number of citizens can see and enjoy the works they are the legacy of the collective capacity of a people.[2] In the case of archaeological heritage, it is difficult for citizens to contemplate and enjoy archaeological remains can hardly get to play. So many archaeologists claim as Joan Santacana long; promote the use of reconstruction as an educational tool in the treatment of the archaeological heritage (Gil and Santacana 2013)

[1]BOE N.155. Sábado 29 de junio 1985, Pág. 20347. In paragraph 2, article 39.

[2]Ibídem. Page 20342.

In the countries of northern Europe legislation it is always more likely to practice in reconstructive archaeological sites. However, its application holds numerous problems in preserving the contributions of different historical periods on the same site, or just time to rethink scientifically forms or uses of the reconstructed structures. Finally, we must not forget that the public can easily fall into the error of considering the materials reconstituted as original and therefore introduce the tendency to value the archaeological remains according to their degree of conservation or reconstruction. None of this would be a problem if the archaeological reconstruction could raise multiple, reversible and interactive with the public way.

4 Augmented Reality and Virtual Archeology

Since its inception, all experts agreed that this paradigm of interaction and information visualization *is the center of a new and very promising technology for many applications in many sectors* (Balaguer et al. 2001: 3). However there he noted that so far *the first tests with Augmented Reality have been linked to the world of archeology showing the advantages and potential that has applied to the heritage field* (Ruiz Torres 2011: 3). This is no coincidence if we note that these resources are able to create inspired by the basic principles of heritage interpretation experience: *participatory tools that provoke curiosity and stimulate the senses through participation in simple applications, facilitating the assimilation of the main theme, inviting him to deepen the content or encouraging him to repeat on another occasion the visit* (Flores Gutiérrez 2011: 1).

Without being too exhaustive, we can select some of the most prominent examples of use of Augmented Reality to spread the archaeological heritage according Gómez García Robles and Quirosa (2009):

– 1997: "TIMEFRAME" Augmented Reality Viewer with high resolution located in the Belgian city of Ename.
– 2000: "ARCHEOGUIDE"; first Augmented Reality application for several monuments of Olympia in Greece.
– 2001: "Vilars"; first Augmented Reality application developed in Spain at the site of Arbeca in Lleida.
– 2002: "LIVEPLUS"; full implementation of Augmented Reality covering the site of Pompeii in Italy.

All these projects have in common a long development process as we have seen, involves first the design of 3D objects themselves who want to bring the Augmented Reality. *These jobs generally require multidisciplinary cooperation of specialists in Virtual Reality, archaeologists, historians or writers* (Gutierrez and Hernandez 2003: 10) So the first problem is to establish a series of guidelines that should mark the completion scientific criteria these virtual images; *which have a* *major impact on the convictions of the public who succumbs to the power of visual images* (Gómez García Robles and Quirosa 2009: 6).

However, we found differences in the different uses to which the Augmented Reality in each of these examples is applied. Following the speech of several authors we can summarize three approaches when using Augmented Reality to publicize the archeological heritage:

– Reconstruction of dilapidated buildings or significantly altered.
– Recreation archaeological missing or damaged parts.
– Simulation of social or natural environments on archaeological sites.

These informative functions, we must add other approaches that consider also useful in scientific contexts generating 3D images to simulate and investigate certain intangible material objects according to Gutierrez and Hernandez (2003):

– an archeological object in its original environment.

Therefore, it is necessary to propose new ways of content associated to this technology that go beyond the simple virtual reconstruction of historical buildings. Through virtual reality it must be possible to enjoy new experiences that couldn't happen in the real world, even where it has already disappeared, and help you better understand what the heritage means beyond their spatial analysis. Regarding this, Gutierrez and Hernandez defend also:

"Incorporating multimedia, multi-exploration, the telepresence and the ability to display worlds in ways that are not subject to the physical limitations of the world we live take this technology to become no longer an emulation of what exists, but an expansion of our own reality". (Gutierrez and Hernandez 2003: 14)

This coincides perfectly with the aim of Augmented Reality that according to Fernandez Alvarez is simply to overcome the difficulties of understanding due to different levels of conceptual abstraction presenting different traditional representation systems (2010: 4) (Fig. 3).

The process for carrying out the reconstruction of a reservoir through Augmented Reality makes sense only if it is preceded by a scientific work. Archaeological research is what should determine both the design and the location of virtual elements who integrate into the current state of the site.

The next step to carry out the integration of 3D objects in the real world, is to establish the scale on which should generate these virtual elements. Whether it is isolated parts partially preserved as a surface area; *It's necessary to carry out a measurement of the real through photogrammetric techniques* (Blasco Senabre 2011) space. From the intersection of photographs or digital terrain model, we can know the dimensions and position of real objects in space and determine the proportion of integrating virtual elements.[3]

[3]Within the field of architecture and product design in this year 2014 the most common are Autocad, 3d-studio, Rhinoceros and other non-commercial software.

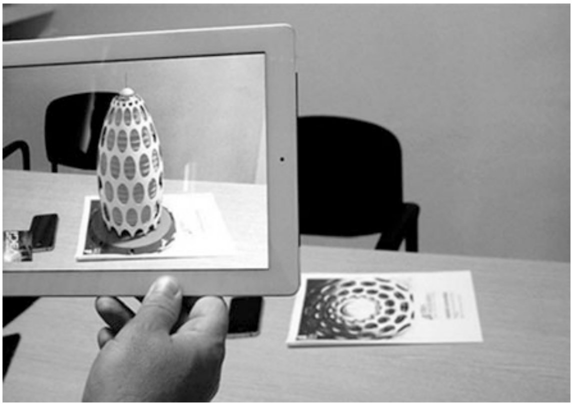

Fig. 3 Promotional image of augmented reality Visuar

Then it will take place the process of creating 3D object through some of the different applications that exist in the market and allow the following steps:

– Modeling: form is given to the figure by geometric objects.
– Set-up: joints or different possible states are created.
– Texture and color: a coating with detail and color are generated.
– Lighting: effects of light on the object are applied to enhance its three-dimensional perspective.
– Render: a final image is obtained in compatible formats.

This whole process can be performed with greater or lesser depth and definition and will provide the key results and the public to where we should direct. This section will discuss later so supposed to differentiate the product created if it is for an expert or simply informative public and what that entails.

Once the 3D object we anchored in the concrete actual location, this is what is known as "positioning" and for it on the market three types of systems:

– Recognition: This is the most advanced technology to the integration of 3D objects. Iconic uses objects found in the real environment as markers to introduce virtual elements. Its use is very sensitive to changes in lighting or certain perspectives, but can be applied easily without considering the geo viewer.
– Markers: It uses a series of similar to BIDI or QR codes in space and to recognize the pen tablet puts the 3D object in the right place geometric markings; code from the three coordinate axes are generated to guide the object. The only requirement is that the resolution of the camera allows the identification of these markers and difficulties lie in the location of codes in different parts of the building and in the correct alignment of the definitions of the object facing the reality that surrounds it. Yet more development is used to date for use on easy.
– Georeferencing: Use the GPS coordinates to locate the position of the 3D object. Eliminates the need for any marker to generate the coordinate axis, but the margin of error in generating the image from the point of view of the viewer is much higher.

Finally, we need a viewer through which an image of the real environment with integrated virtual elements. In this case, we must take into account the size of the device and the screen resolution or the ability to geo instruments available to it. To date, they have developed various types of devices to display Augmented Reality:

– Viewers: static screens are large offering an overview through a fixed and allow replace 3D image camera.
– PDA: They are smaller portable viewers that store 3D images and synchronized with the place in which it is located.
– HMD ("Head Mounted Display") This is glasses for viewing 3D[4]
– images, so perfectly synchronized with the movements of the subject leads.
– "Smartphones" or tablets: These are generic devices through specific Internet applications, as well as carrying the camera built for viewing Augmented Reality.

As stated Redondo Dominguez, the successful development of the "Augmented Reality" it has occurred when it has been possible to apply from mobile phones last generation, equipped with cameras of high quality and processing power and connectivity (2012: 10). Therefore the current standard for this technology are applications for "smartphones" that run through recognition of markers in the real world.

5 The Future of Augmented Reality in Architecture

Once recognized the technology developed, we face the same analysis from a critical point of view, assessing their suitability to the discipline that concerns us is the architecture and within archeology. Augmented Reality is developing at breakneck speed in various branches of knowledge as in video games, tourism and even in medicine, which is used for testing operations or to allow the surgeon to superimpose visual data and see the delimitation of clean edges one, invisible to the eye, thereby facilitating procedures tumor.

In the field of architecture and archeology RA development it is now closely linked to archaeological recreations linked to tourism and real estate development and the results are beginning to be really interesting quality and recreation. While it would have to take a step beyond its possible use in creative fields and constructive for what greater precision and technicality necessary phases. For now the difficulties are emerging in this new technology are several although evolution is very fast and at the time this article is published has been able to advance a few more steps and new problems have appeared.

[4]The best known are the google-glass, although there are others such as the Epson Moverio BT-200.

One of the major difficulties is when developing projects Augmented Reality is that visual elements must be coordinated perfectly with real objects, since a small error of orientation can cause noticeable misalignment between virtual objects and physical that you remove all likelihood to experience. Another of the difficulties the RA with the incorporation in architecture is the ability recreation with architectural quality. As well as other specialties acceptable iconic or near the object represented as in traffic or surgery, archaeological recreations quality "render" and lightings have to be more realistic images are, as we have already used to that level of definition in our jobs and everything that is not equal will lead to implausible and rejectable recreations in this professional environment. In this case the lighting models and matching lighting environment is key to successful integration. Keep in mind that the possibility of changing the point of view that gives us the RA, also requires illumination change of location taking into account changes in the days, seasons and hours of the day. These and other difficulties lead us to continue to research in this field from a critical point of view and to invest in it, both economic resources and people.

In the field of architecture its current developments incident from a point of view of promotion ahead of a sale of the product to the customer, where still some images are undeveloped for more professional requirements so in that aspect should influence the lines of future development. But then without abandoning this line, we should develop technical tools such as in-depth analysis of constructions, visualization tools different constructive solutions in creative processes but also restoration and maintenance. This line of work would allow us to use the RA almost like an X-ray or thermal imaging camera that allows us, from where the database building, visualize the inside of the walls where the structures and facilities are located, and to act in time and actual location.

Despite the widespread applications of Augmented for "smartphones" Reality, there is still much to improve the integration of 3D objects in the real world. Everything indicates that Augmented Reality is one more link in development initiatives in architecture and is therefore likely to be overtaken by new technologies that improve the ability to recover the past, so an exciting world where development opens new technologies, but always in the hands of a critical analysis to ensure its suitability for architecture and archeology with the minimum standards required by our scientific community.

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Julián de la Fuente Prieto B.A. in History and B.A. in Communication Studies. Working as an independent producer and director since 2002, he has made all kinds of audiovisual materials such as ads, reports and music clips. He has also created holographic facilities, 3D projections and interactive apps. He has several publications on film and history and has conducted several outreach projects for film heritage. He currently teaches at Universidad Europea Madrid and the University of Alcalá.

Correction to: Graphic Analysis Between Teaching and Research. Mario Ridolfi Unbuilt

Virginia Lorello and Francesco Maggio

Correction to:
Chapter "Graphic Analysis Between Teaching and Research. Mario Ridolfi Unbuilt"
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https://doi.org/10.1007/978-3-319-58856-8_39

In the original version of the book, the following belated corrections have been incorporated in the chapter "Graphic Analysis Between Teaching and Research. Mario Ridolfi Unbuilt": The author "Virginia Lorello" is to be added as the first author of the chapter, and the author "Vincenza Garofalo" is to be deleted. The correction chapter and the book have been updated with the change.

The updated version of this chapter can be found at
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