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Jerzy Charytonowicz *Editor*

Advances in Human Factors in Architecture, Sustainable Urban Planning and Infrastructure

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Editor
Jerzy Charytonowicz
Faculty of Architecture
Wroclaw University of Science
and Technology
Wroclaw, Poland

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11th International Conference on Applied Human Factors and Ergonomics and the Affiliated Conferences

Proceedings of the AHFE 2020 Virtual Conference on Architecture, Sustainable Urban Planning and Infrastructure, July 16–20, 2020, USA

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Preface

The discipline of Human Factors in Architecture, Sustainable Urban Planning and Infrastructure provides a platform for addressing challenges in human factors and engineering research with the focus on sustainability in the built environment, applications of sustainability assessment, demonstrations and applications that contribute to competitiveness and well-being, quantification and assessment of sustainable infrastructure projects, and the environmental, human, social, and economic dimensions of sustainable infrastructure. A thorough understanding of the characteristics of a wide range of people is essential in the development of sustainable infrastructure and systems and serve as valuable information to designers and help ensure design will fit the targeted population of end users.

This book focuses on the advances in the Human Factors in Architecture, Sustainable Urban Planning and Infrastructure, which are a critical aspect in the design of any human-centered technological system. The ideas and practical solutions described in the book are the outcome of dedicated research by academics and practitioners aiming to advance theory and practice in this dynamic and all-encompassing discipline.

A total of five main sections presented in this book:

Section 1 Architecture for People - Present and Future
Section 2 Architecture and Urban Planning
Section 3 Ergonomics in Building and Architecture
Section 4 Ergonomics and Material Environment Design
Section 5 Ergonomics in Urban Design

Each section contains research papers that have been reviewed by members of the International Editorial Board. Our sincere thanks and appreciation to the board members as listed below:

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We hope that this book, which is the international state-of-the-art in Architecture, Urban Planning and Sustainable Infrastructure domain of human factors and ergonomics, will be a valuable source of theoretical and applied knowledge enabling human-centered design for global markets.

July 2020 Jerzy Charytonowicz

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Architecture for People - Present and Future

The Experience of Glass Architecture − A Case Study

Joanna Krajewska(✉)

JKK Studio, Wroclaw, Poland
j_krajewska@op.pl

Abstract. Since the end of the last century, more and more glazed buildings are being built in large cities around the world. They become places not only for work, but also for living. Thus more and more people experience space on a daily basis through a glass facade. The aim of this work is to present the results of the research conducted on a case study of experiences and every-day practices of glass architecture users. For a detailed research the building of the Centre for Applied Arts and Innovation of the Eugeniusz Geppert Academy of Art and Design in Wroclaw (Poland) was chosen, opened in 2012.

Keywords: Glass architecture · Transparency · Building user

1 Introduction: Glass Architecture as an Object of Everyday Experience

Glass architecture due to its growing global popularity constantly increases its influence on contemporary human environment. More people experience urban space through a transparent wall every day. Glass elevation appears to be treated as a remedy for the urban density, as it gives an impression of dematerializing solids due to reflecting other buildings. On the other hand − glass façades in front of building users open the view to the high-stimulus urban context, enabling visual penetration of the interior by external users. The glass façade separates the interior from the outside, however at the same time it connects them, blurring the border between the two sides. It creates a relationship full of possible tensions. Therefore, there are problems important from the point of view of users' experiences, namely: daily habits, privacy issues, perception of the distance of the world outside the window and the degree of participation in what is happening outside. Considering the fact that there is a dialectical relationship between man and his environment [6, 10], it can be expected that functioning in glazed buildings is accompanied by specific practices that can be learned during field studies.

Man experiences the world around him in a holistic, multi-sensory way, through his body [7], which provides him with numerous information about staying in a specific environment. When the elements of material environment − their scale, form, texture and spatial qualities are positively classified, it provides existential support to a man [8]. Thus, the quality of experienced architecture every day is a very important issue. Hence it was justified to undertake research whose main aim was to gain knowledge about the experience of glass architecture by its users and to learn about their daily practices.

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2 Qualitative Research Within the Chosen Building

The analysis of experience and daily practices of glass architecture users was made on a case study. Qualitative ethnographic research (field study) was to allow the deepest possible understanding of the issue.

2.1 The Centre for Applied Arts and Innovation

For a case study the new building of the Eugeniusz Geppert Academy of Art and Design in Wroclaw was chosen − the Centre for Applied Arts and Innovation, opened in December 2012. The project designed by Pracownia Architektury Głowacki PAG was selected for realisation by means of an architectural competition decided in 2007. At the stage of establishing competition guidelines, the specific needs of users of the future Academy building were taken into account, from whom information on the spatial requirements that the project should meet were collected.

Seven-storey, L-shaped building is located in the city center. Elevations are made of modular glass panels covered from the outside by ceramic raster. Northern side of the building opens to a busy traffic junction, the Eastern one − to a small park. In the very vicinity there is the original ASP building, where some academics have their studios and where classes are still taking place. The Center houses art studios, classrooms and a mini-glassworks. Two-story studios are located on the eastern side. Minimalistic building interior is dominated by concrete (walls, floor) and white color (walls).

2.2 Building Users and Research Method

The main research method adopted for the study was a structured interview method with the elements of an unstructured interview, as well as observation method with varying degrees of participation. The questions based on the author's questionnaire were divided into 3 sections and concerned: the characteristics of a person's work/studies and their attitude to the workplace/studies, user's practices due to glazing, and architecture.

A preliminary assumption was made to conduct about ten interviews, but their actual number was to depend primarily on the value of the information collected (a diverse mosaic of attitudes, interesting data allowing rich interpretation, etc.). In order to gather information in the widest possible range of users of the selected building, the research was conducted not only in the academic environment, but also among the other Academy employees.[1]

[1] In total, interviews were conducted with over a dozen people aged between 20 and 70, including research and teaching employees, glassworks employees, students, as well as the deputy Head of the Technical and Economic Department and a doorman. Some interlocutors spend 8 h a day in the building, some use it several times a week; there was also a person who visits the Center occasionally for professional reasons. Two of the professors still have their studios in an old building nearby. The average time of the interviews was 45 min.

Important was the observation of everyday life in the Center, as it enabled an insight into various, not always verbalized by the interviewees, practices of using this place.

Research was conducted in March and April 2018, more than five years after the building was opened. Interdisciplinary literature studies, which constituted a significant interpretative framework for the respondents' statements, were helpful in the material analysis.

3 Case Study − Results

The following are the main issues that emerged from the field studies that are relevant to architecture and interior design.

3.1 Light for Activities Inside the Building

The glazing of the elevations and the use of ceramic raster was to ensure sufficient lighting of the studios with diffused daylight. However, as field studies have shown − lighting conditions are not optimal for all the building users, as their needs and preferences are varied.

A workplace flooded with natural light can have a positive effect on users' mood and their willingness to work. It happens, however, that excessive lighting is undesirable due to the function of the room. An example is a burner workshop located in the northeast corner of the building. It could be solved by controlling the amount of light passing through, but the project did not provide for such a possibility. In this situation people in burner workshop separate themselves from glass elevation by using mobile furniture. In addition, they also changed working hours due to lighting conditions in order to avoid morning light. What is more, regardless of the user's needs, excessive amount of daylight can be seen as "a bit scary"[2], as one interlocutor said.

Despite the use of large glazing, satisfactory access to natural light has not been achieved everywhere. In one of the studios in the northern part of the building, the concrete gray surface with suspended installations with large pipe cross-sections changing the room's proportions (height-to-depth ratio) additionally caused that the permanent user found the lighting insufficient.

Finally, not only the rooms location in relation to the sun, but also the external architectural context influences the rooms illumination as a result to the amount of reflected light entering the rooms.

3.2 Meaning of Glazing

The glass façade, in addition to providing a full access to daylight, also determines the relationship with the exterior (and sometimes mutual relationship), which affects, among others, the emotional state of users.

[2] Phrase appears in the interview conducted by the author at the Center on 03/26/2018.

The respondents indicated as a significant contact with nature, the possibility of observing the variability of seasons, while most of them admitted to feel discomfort due to a possibility of being seen from the outside.

One person emphasized the importance of glazing − and the associated opening of space − as a kind of counteraction a feeling of claustrophobia in the raw interior and for the state of being "overwhelmed by solid"[3]. Positive reception of a full glazing by one of the interviewees (located in the studio from the greenery side) was associated with a feeling of being outside without leaving the building.

However, depending on the location of the room in the building and the view outside the window, this opening of space can be percepted in a negative way: One of the respondents, despite considering openness to the outside as the most characteristic feature of the Center, feels as if he worked on the intersection itself, as his windows overlook a busy traffic junction. The user of another studio, opened in the same direction, considers the space outside "very disturbing"[4] − glazing makes her feel the street running behind her all the time.

Dynamics of the image still present in the field of visual perception, due to the lack of visual barriers, and limited possibility of making an individual decision about participation in the life of the city adversely affect the building users.

3.3 Distance from the World Outside

The impression of work "at the intersection" and "movement behind the back"[5], which were mentioned in the interviews by people working on the street side, are related to the perception of the distance between the person and the world outside the window − the proxemic distance[6].

Visual contact with nature, with a static view outside the window, gives the person in the room a sense of distance described as "safe"[7], despite full glazing. In contrast to the above, the dynamic, full of stimuli external space creates the situation in which the distance between the exterior and the user of the building can be described as "unsafe". The spatial relationship with the exterior prevails over the building itself. However, comfort associated with a sense of distance to what is outside can increase with the height[8] of the room location in the building. In this case the ceramic print on the glass creates visual barrier[9].

[3] Phrase appears in the interview conducted by the author at the Center on 03/28/2018.

[4] Phrase appears in the interview conducted by the author at the Center on 03/26/2018.

[5] Phrases appear in the interview conducted by the author at the Center on 03/26/2018 and 03/27/2018.

[6] According to the definition of Edward T. Hall, "proxemics is the name for observations and theories regarding the use of space by man" [4, p. 149]; self-translation. It is worth noting that, according to Hall, the perception of space is closely related to action, not to what can be seen [4, p. 167].

[7] A term used by one of the respondents.

[8] A separate issue is a possible fear of heights or fear of space felt by a building user.

[9] On the other hand some criticize that the print distorts visual perception, interfering with the view outside.

A separate issue is the sense of distance between the building user and the external space related to experiencing a glass elevation as a wall. One of the respondents realized that she perceives permanent glazing as a physical barrier separating her from the exterior due to the lack of physical interaction with the world outside and lack of agency (inability to open a window).[10] One can therefore note that the glass façade condemns a man to a state of passivity. For some users, facing a situation of separation, the world outside the window becomes flat in reception, acquiring the characteristics of an image.

Being behind a transparent wall sometimes evokes associations with the aquarium − with a state of imprisonment in the face of an asymmetrical relationship: to see − be seen. One can find here references to the project of Jeremy Bentham's prison and the idea of metaphor of permanent surveillance [3].

3.4 Relationship with the World Outside

The type of relations between the building users and the outside world, which is separated from them with a glass façade, is a particularly interesting issue due to the ambiguity inherent in the nature of glass, as this material can both create a border and level it [2, p. 227]. The research have shown that a transparent wall can both connect a building user and its surroundings and separate him, and that reception of such spatial relationships can be both positive and negative.

Some respondents feel as a part of the world outside the window, as if the building and the exterior constituted to one whole space. According to the other ones, the world behind the glass appears as an "option", leaving control of the situation and agency on the side of the user who considers himself an the observer of the events outside.

The intention of the designer was that through glass façades, pedestrians could see the inside and observe working artists. One of the respondents admitted that she enjoys it when the lights are on. Full glazing of the elevation allows visual contact between building users working on the lower floors and pedestrians. When both parties know each other, it happens that it comes to a direct interaction between them − they are greeting each other or a person from the outside is visiting a friend in the studio. A person sitting in a particularly exposed place admitted that finally she had felt discomfort associated with it − as if she was sitting on a display window and overexposing herself. The confession indicates the oppression of being seen from the outside, making the glass building an inverted version of the Panopticon. The presented situation might be solved with a change of the interior arrangement in the way that the permanent user of the studio is not visible from the outside anymore.

Research has shown that aggressive, unwanted stimuli (movement, sounds, smell) coming from outside can be intensively perceived both by the senses as well as at the level of the psyche, especially at the beginning of the use of rooms. After some time one can work out a way to deal with unwanted stimuli and relieve tension, but one probably still subconsciously feel anxious. In addition, this is not always successful.

[10] This confirms the claims of Edward Hall, who believed that the perception of space is closely related to action, not to what can be seen [4, p. 167].

One interview revealed, however, that in the face of a tragic event outside, the glazed wall does not seem to exist, making the user of the building an accidental, one could say a "trapped" witness. This is another example of the violent aspect of the glass façade, which means that a building user is not only exposed to public view, but forced to passively participate in social reality.

As mentioned above − contact with greenery outside the window is desirable for the users. The proximity of nature is soothing and gives, among others the possibility of observing the variability of nature's cycles despite staying indoors for a long time. Glazing also allows the introduction of greenery into the interior − also plants of considerable size, an example of which is a 4-m high banana tree standing in one of the studios.

Studies have also confirmed that there may be a sentimental bond between a building user and the view outside the window.

3.5 Intimacy

According to Heidegger, the purpose of architecture is to indwell [5]. Observation reveals that in the case of a long stay in a room intended for work, additional activities of users appear, including social conversations, eating meals, caring for plants, etc. − which give the used space the character of being indwelled. Therefore, a need for intimacy appears among the users, which is particularly raised in the context of glass architecture.

During the field study at the Center, the issue of the sense of lack of intimacy has emerged. The question of oppressiveness of being seen returns. According to some respondents, the print on the glass at least partially increases the comfort of staying in the object, at least while the lights in the building are not yet lit. During one of the conversations the need to "retreat" in the face of such a widespread opening of space was revealed, in another − the need to "hide" from excess light.[11]

Observation shows that informal places, arranged by employees, are located deep inside the room; if they are close to the façade, this is from the side of the green courtyard. In the face of the overwhelming scale of the room and the feeling of being over-stimulated due to external stimuli, one interviewee pointed to the recurring need to isolate herself − as a convenient place to stay alone with her thoughts she is choosing a white toilet in the building.

Walter Benjamin stated that "glass defies a secret and ownership"[12] [2, p. 166], while intimacy goes hand in hand with a secret, it needs both a place to collect and hide objects [1] and a place where one can hide himself. Employees arrange the interior with additional not related to the work equipment, designed to increase the comfort of use and meet the need for collection (soft armchairs and shelves), clearly indicates the practice of taming the existing, raw space and giving it the character of a home [see: 1, 9]

[11] Terms used in the interviews conducted by the author on 03/19/2018 and 03/26/2018.

[12] Self-translated.

4 Conclusions

The obtained research results may sensitize designers to the needs of glass architecture users, which are diversed and depend on many factors. Thus, reception of glazing depends on the location of the room in the building (relation to the sun and to the groundfloor), view outside the window, lighting appropriate for the work, scale and color of the room, and finally the possibility of separating "intimacy" zones within it.

Depending on the view outside the window (nature/urban environment) there are differences in the perceived proxemic distance ("safe"/"unsafe").

Furthermore, the research revealed the violent aspect of glass architecture, the use of which not only leads to being in view, but also forces the user to participate in social life outside the transparent wall. A glass façade is seen by some interviewee as a barrier to physical agency within the available visual space. Providing a privacy zone within the glazed interior can increase the comfort of a long-term staying in a building. Moreover it also provides a remedy for the discomfort of being seen from the outside. Field study gave an additional confirmation of a statement, that desirable working environment is created by contact with nature in the form of not only the view outside the window, but also the presence of plants inside the building.

Some of the presented situations are an example of staying in a stressful work environment due to the glass façade of a building − this thread could be the subject of further, in-depth research.

The ethnographic research methods used in the described case study can be applicable to further research on quality and function problems of the users of glass architecture as well as other contemporary architectural solutions.

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Adaptive Reuse of Bank Buildings Towards Promoting Sustainability Environment

Krystyna Strumiłło(✉)

Lodz University of Technology, Institute of Architecture and Urban Planning, Al. Politechniki 6, 90-924 Łódź, Poland
kstrumillo@interia.pl

Abstract. The purpose of this paper is to show the importance of activities related to the re-use of the bank buildings as part of sustainable development policy. Existing old and historic bank buildings have great architectural potential. It should also be mentioned that bank buildings are among the most crucial constructions in the hierarchy of city buildings and as such, they are a testament to the cultural heritage of cities. Preserving them in the city structures enriches social capital, cultural value, and tradition. In this context, the adaptation of the bank buildings to perform new features seems very well-founded, but above all, it becomes important for the promotion of sustainability environment.

Keywords: Adaptive reuse · Adaptation · Bank buildings · Cultural heritage · Sustainability environment · Sustainable development

1 Introduction

Space and the built environment have a relatively short warranty period. Over the last few decades, the shift towards the reuse and adaptation of existing buildings has become an increasing trend. One reason for the interest in adaptation is the growing perception that old buildings are often cheaper to convert to new uses than to demolish and rebuild. The economic factor translates into the environmental aspect. While there are various and divided opinions about the costs, adaptations are worth examining. It is necessary to notice that changes in banking are very fast. Nowadays, old bank buildings usually neither meet the modern requirements of new generations and technologies nor the demand. For all these reasons, banks and their areas often undergo urban transformation processes - reuse, revitalization or reconstruction. It can even apply to new bank buildings that have not been able to operate for a longer time [1]. Also, cultural heritage can play a key role in achieving sustainable development. Old, historical banks and their areas often have high architectural and cultural value that should be preserved. These activities are part of the strategy for improving sustainable development. There are some international organizations, such as the UN Educational, Scientific and Cultural Organization (UNESCO) and the International Council on Monuments and Sites (ICOMOS) that stress the importance of cultural heritage in the achievement of sustainable development [2].

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2 Sustainable Development Today

The concept of sustainable development was created at the end of the 20th century in the context of ecological crisis, environmental protection challenges, and energy problems. Based on the Brundtland Report (1987), sustainable development was defined as economic development that assumes the fulfillment of current needs without reducing the chances of future generations to meet their own needs. Above all, the awareness of future problems related to nature, natural resources, economy, and society speak for sustainable development. Today, sustainable development is of particular interest and involves many different economic, social, natural and technical disciplines. The approaches of individual scientific disciplines to sustainable development and the perception of the structure of natural capital, man-made capital, and the degree of sustainability are of key importance.

There is a strong economic, cultural and environmental connection between adaptive reuse and sustainable development. The protection of cultural and natural heritage is the basis for sustainable development. Extending the life cycle of a building through reuse can lower material, transport and energy consumption, and pollution - and thus make a significant contribution to sustainability. According to Bullen [3], estimating the costs of adapting an existing building versus constructing a new one was perceived as more difficult - but it was even more difficult to provide the value of social and environmental factors of sustainability. The social aspect of sustainable development is also important, which primarily means that the building should be user-friendly. What counts is the care for health, comfort, and safety of users. Therefore, building-user-environment relations are important.

3 The Potential Behind Bank Buildings

Banks are public buildings and facilities that are located in public space to fulfill the tasks of satisfying social and public needs by providing publicly available services. Facilities with public functions are located in public places that are particularly exposed and important for local communities. Revitalized public buildings, following the requirements for buildings, should have the same technical equipment as the newly designed buildings [4]. Reuse applies to buildings that, for various reasons, have lost their utility functions and ceased to fulfill their primary tasks. Revitalization is a complex process of spatial, technical, constructional and architectural changes, the purpose of which is to bring a building out of a crisis, restore its function or create new functions and conditions for its further use.

It is necessary to be aware that revitalization involves complex construction processes and there are various technical problems to be solved. The task is difficult but repeatedly successful.

It is important to properly perform the adaptation of the buildings. The process should preserve the value, emphasize new values, minimize the cost of use, and satisfy the investor. The design phase should start with the concept and discussion of design assumptions in the light of conservation requirements and the needs behind new functions. It is the spatial arrangement of the historic object that should determine the

possibility of entering a new function, and not the other way around. The basic tasks are: improving the technical condition, equipping the building with modern installations, the possibility of adapting individual floors, changing the heating method to allow energy efficiency.

There are many examples of bank building adaptations in the world. They should now be in line with the principles of sustainable architecture. We do not always have the information on the building certificates obtained but according to Love and Bullen [5], from a sustainability perspective, it will almost always be a more viable option to use an adaptive re-use strategy. The analysis of selected adaptations illustrates which functions are preferred for the new life of the buildings. Bank buildings are usually adapted to residential, hotel, and commercial functions. It is worth mentioning that in the United States there are incentives for investors who decide to adapt and reuse the existing facilities. The following examples may illustrate the scale of the phenomenon of re-using historical banking facilities for new functions. These examples apply mostly to bank buildings in large cities. The first is the First National Bank Building (built 1913) in Richmond, Virginia, which was an iconic downtown bank. This bank building is an example of turn-of-the-century Neoclassical Revival architecture. The 19-story tower is listed in the National Register of Historic Places and was the city's tallest building for years [6]. The adaptive reuse of the First National Bank Building added 154 new apartments (along with a fitness center, community room, game room, secured garage parking) and amenities to downtown Richmond's urban lifestyle.

In turn, the old Bank of Montclair (1923) built in the heart of downtown Montclair, NJ, was adapted for offices and commercial services [7]. The town of Montclair is committed to maintaining its historic downtown and the innovative adaptive reuse of the Bank of Montclair building followed the historic preservation guidelines.

A similar example is the Colorado National Bank in Denver which was converted into a hotel. The property showcases historic elements from the building's original early 20th-century construction. Many of the historic elements of this building, including the artwork, are still intact, giving the great hall a very historic feel with some modern elements. The building adaptation enabled the creation of 230 hotel rooms, restaurants, a bar in the lobby, and a fitness room [8]. The structural layout made it possible to create hotel rooms with various plans - from small studios to apartments.

Another example is the historic Farmers and Mechanics Savings Bank building in downtown Minneapolis. For several years it was completely abandoned but the building was restored and innovatively converted into a boutique hotel facility. The great banking hall was transformed into an entirely new space that serves as the heart and soul of the Westin Hotel. Maintaining the nature of the banking lobby while inserting new functions was a challenge and in this respect, the need to create hotel rooms in the existing construction grid was a particularly difficult task.

The next successful adaptation is the First National Bank Building in Albuquerque, New Mexico. It is a 9-story, L-shaped building which was the city's first skyscraper. Built 1922, the building was owned by First National Bank (later First Security Bank) until the year 1999, when it was purchased by a private developer who planned to convert it into a luxury hotel. Plans changed, and the building was remodeled into a high-end condominium project called The Banque Lofts that opened in 2006 [9]. The project included the original exterior esthetics, new heating, and air handling systems,

as well as improved electrical and fire protection. Seaboard Building (built in 1909), located in the heart of Seattle's retail district, also gained residential functions (2001). The building was formerly known as the Northern Bank and Trust Building. It was registered as a National Historic Place in 2003. Another example is Planters National Bank, also known as the Old Planters Bank in Richmond, Virginia, which was built in 1893. The adaptive reuse of this facility was awarded The Historic Richmond Foundation's Award of Achievement and a Virginia Society AIA Merit Award for Excellence in Design for its successful integration of a Richardson Romanesque bank structure with a modern office addition and a 250-car parking space [10].

In Chicago, one of the banks that gained new life is The Stony Island Trust and Savings Bank Building constructed in 1923. After adaptation, the building houses an art gallery and library named Stony Island Arts Bank [11]. The bank performed its function for about 60 years, until the early eighties but it underwent gradual degradation. Due to its architectural and cultural values, it was decided to preserve the building. The adaptation was a big challenge concerning the flexibility of both functional and construction solutions. The building was reopened in October 2015, on the first day of the city's premier architectural biennial. It was recognized that in the long run, the refurbished facility will generate economic benefits. In Chicago, it is also worth mentioning two other historical banks have been used for new functions as drugstores. These are the Home Bank and Trust Company, and the Old Noel State Bank Building.

In New York, historic banks are not so rare either [12]. Former New York banks are most often adapted into drugstores, hotels, apartments, and stores. Examples include the New York Savings Bank (1897) in Chelsea (first named Rose Hill Savings Bank), which in recent years has been adapted to the needs of CVS Pharmacy. Many other old historic bank buildings in New York are currently occupied by CVS Pharmacy. Among others, it is the branch of the former East River Savings Bank (1926–27), (building which still recalls the grandeur of Greek and Roman temples), and the New York County Bank (1907), in front of which the New York Savings Bank is located. It was designed with both Classical and Beaux-Arts influences. It seemed as if the two buildings and banks were competing both in business and style. The County Bank was the first to be closed. For a short time in the mid-'90s, the facility served as a theater but then in 1999, it was converted to its current dual function. It is now divided into condominiums and the Museum Of Illusions [13]. In turn, the Williamsburgh Savings Bank Tower (built 1927–29) is a skyscraper located in downtown Brooklyn. This bank building was transformed into luxury condominium apartments under the name of 1 Hanson Place. A similar function was obtained by the Apple Bank (1928) located at 2112 Broadway at 73rd Street. In 2006 this former bank building was converted into 29 condos.

Adapted banks acquire new public functions. Apart from playing residential, hotel or commercial functions, they are also transformed into venues for organizing special events, such as weddings and various receptions. In New York one of the examples is the headquarters of the Bowery Savings Bank at 130 Bowery which was built in 1893–1894. It currently houses a restaurant and event space [14]. In turn the Greenwich Savings Bank building (1922–24) on Broadway was transformed into Gotham Hall, an iconic Midtown event space. The interior rotunda with its coffered dome is particularly impressive [15]. In Canada, an interesting example of reusing bank buildings is the Royal Bank Tower in Montreal (1928). This bank used to be the tallest building in Canada for some time and is now intended for offices and a cafe [16].

Among adapted bank buildings in Europe, the Kas Bank Building in Amsterdam is particularly worth mentioning. The building was designed in 1908 and expanded in stages until 1932. The construction follows the classical typology of bank buildings with vaults on the ground floor and basement, a monumental bank hall on the first floor, and offices located above. This building is one of the first concrete constructions in the Netherlands and features a sandstone facade. The adaptation carried out there was meant to respect the nature of the historic bank building while providing the necessary improvements. The former banking hall now houses a bar and restaurant, there is also a spa, a creative incubator, as well as space for Dutch artists to present their fashion, art and design works [17]. The upper floors have been transformed into a hotel.

These adaptive reuse of buildings is considered a means for conveying the legacy of the past, which consists not only of heritage buildings as physical items but mainly of the wealth of information provided by each element they are made of.

In Poland, many historical banking facilities still perform their function, but some of them have been revitalized. It is hard to miss the adaptation of the former Bank of Poland in Warsaw. The building was built in 1910 and became the symbol of solidarity and trust. It is located in the very heart of the historic part of the city on Bielańska Street, next to Teatralny Square. During World War II it was the last redoubt of the struggling Old Town. After the war, a large part of the damaged building was demolished. Only the west wing prevailed and was entered in the Register of Historic Monuments. In 2007, archaeological works were carried out on the site in connection with the planned office facility construction works which were completed in 2012. The building called "Senator" preserved the outline of the previous building walls and in its interior, the former bank's operating room was reconstructed. The western historic part of this building is designed to play several different functions, including a photo studio where prestigious sessions and exhibitions take place.

We must remember that the adaptive reuse of an iconic building is always complex. Many factors are affecting the success (or failure) of an adaptive reuse project. The new functions play a key role in adaptive reuse projects as they ought to meet and satisfy the needs of our ever-changing society and, at the same time, should not compromise the possibility for future generations to enjoy the original resource [18].

4 The Meaning of Adaption in a Sustainable Environment

Reusing a building is a process that benefits from the existing energy and the quality of the original facility dynamically and sustainably.

Revitalization of public buildings following the principles of sustainable development is an interdisciplinary, complex and multi-faceted process. It requires good organization and management that consider the complexity of issues. In the world and Europe, adaptation processes are carried out with considerable success, taking into account environmental benefits. However, it should be mentioned that the practical experience to date in Poland shows that full implementation of this process is rare and has been carried out only recently. Until now, few revitalized public buildings in Poland have received certificates of multi-criteria building assessment systems.

Restoration works do not always involve changes in use, they can restore the building to its original state, while renovation modifies the building so that it can meet current standards. Adaptations extend the life cycle of buildings, but the quality of the adaptive reuse interventions depends both on the quality of the architectural project and the adequacy of the new intended use - both concerning the building itself and the urban context in which it is located.

The main objective of the reuse of buildings is to improve the quality of life while reducing the energy consumption necessary for this building to function. It is also assumed that material consumption will be reduced. Based on all these assumptions, as a result of modernization, the building retains its original functions or gains new ones, but the conditions of its use are improved (e.g. heating and utility consumption costs are reduced). Adapted buildings should meet the requirements of sustainable development, obtaining relevant certificates (including BREEAM, LEED) that confirm their actual state and determine their impact on the environment. Adaptive reuse of facilities is the process of converting existing buildings into new, modern and eco-friendly facilities. A sustainable building should increase social equity, cultural and heritage values, traditions, human health, and social infrastructure, as well as contribute to the development of safe and healthy environments. Moreover, a sustainable building has to consider its impact on the physical and mental wellbeing of its users, too [19].

The reuse experience dates back a long way, but today we have a deeper understanding of its strategic importance. Considering the built environment as a resource does not only mean acknowledging its value as a result of human work or as a useful object. The built heritage can also acquire value for its talent to tell stories, to broadcast knowledge, and to recall the past, traditions, and shared knowledge. In other words, it can be a source of cultural value. Adaptive reuse of bank buildings has proven to be a promising strategy for preserving cultural heritage and promoting sustainable development.

5 Conclusions

Urban space is a modern living environment for modern people, the sustainable design of which ensures appropriate quality. Sustainable architecture, therefore, contributes to the fulfillment of basic human needs. Preservation and protection of many built cultural archetypes that already exist, combined with concern for cultural continuity, create enormous environmental benefits. Reusing facilities promotes sustainable development.

The most successful heritage adaptation or reuse projects are those that respect and retain the original significance of the buildings considered and add a contemporary layer to them to provide value for the future. The revitalization process of bank buildings carried out following sustainable principles stimulates the introduction of innovative technologies and modern construction and material solutions. Combining economic, ecological, and social and cultural benefits, it also contributes to economic recovery. Also, adaptations of such important public facilities increase the attractiveness and the quality of the cities in which they take place.

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The Research on Relation Between Human Factors and Construction Environment Among Guiding Design of Comprehensive Transportation Junction

Yi Su[1,2], Fan Zhang[2], Jian Ping Luo[1], and Gang Liu[1(✉)]

[1] Academy of Arts and Design,
Tsinghua University, Haidian District, Beijing City, China
liug2019@mail.tsinghua.edu.cn
[2] Accessory of Arts and Engineering, Beijing Institute of Fashion
Technology School of Fashion,
No. 2, East Sakura Street, Chaoyang District, Beijing City, China

Abstract. The major goal of this thesis is to study how to design signage system in comprehensive transportation junction better and establish a more thorough designing principle against man-machine relationship for signage system, with the base of comprehensively concerning on all influencing elements of built environment. By completing the relevant designing principle and enhancing the actual rate of application, the passengers traveling experience and service efficiency of staffs can be well improved. PEST analysis, case studying and other methods are used to get the features of comprehensive transportation junction, development trend and innovation direction of signage system. Observational method, user's trip map, field investigation and users interview and other methods are also applied in this research to find out problems on existing signage system, in this way to find out influencing elements of built environment, and excavate user's demands. Major innovation point is when defining the human-machine relation of signage system, we also analyze the influence of built environment relation to signage system. With this research, we have formed up the designing system and method on signage design and influencing elements for built environment, and built up a more comprehensive principle of human-machine relation for integrated passenger station signage system.

Keywords: Human factors · Transfer guidance · Wayfinding · Signage · Built environment · Transportation hub

1 Introduction

Signage system is important to lead occupants to circulate [1], and it is very important especially for urban planning and traffic safety improvement, there are some successful cases [2, 3]. The guidance system will affect the emergency escape efficiency of the building [4]. The guiding system in the shopping place will also affect the shopping

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experience of consumers [5]. In the hospital, a good guide system can help users find the medical department more easily [6, 7].

The key goal of signage design is about how the passenger could arrive at destination safely with high efficiency in large scaled transportation junction. However, with the increasing on volume of traffic hubs, and the complexity level of constructions, at present there appeared a lot of problems on signage system in stations of China. On the other hand, this problem appears in all public places of the world. In the way, the lack on human touch because of disadvantages in signage design is more outstanding.

The high efficiency traffic system can not only promote the development of economy, but also an important symbol of improvement of service quality on urban infrastructure. So it's very important about how to formulate a pack of comprehensive signage system on comprehensively considering all types of influencing elements.

Comprehensive passenger terminal stands for the comprehensive passenger service system with over 2 types of modes of transportation in one building. As the space of hub building is huge, and the demands of passengers are very complicated, so signage system with clear information is highly required to guide passengers to reach their destination fast and safely. To reach good experience, systematic design and elaborate design is required. In this thesis, high-speed railway stations in China are the major research background, to state the influencing elements of built environment in signage designs among comprehensive passenger hub.

2 Overview on Influencing Elements in Built Environment of Signage Designs

Though relevant principle for signage design exits in our nation including <designing guidance for signage system in railway stations>, a lot of which appears with problems during practical uses. As shown in the image below, beside relevant to passenger demands, the signage system is also closely concerned to building spaces, service system, city culture and other elements of the station.

To improve the humanization of signage signs, all kinds of elements during the designing and researching process shall be comprehensively concerned. Such as the relation drawing in Fig. 1, in the following texts we will analyze the influencing relations of which.

All types of transportation functions and passenger demands shall be taken into consideration of the designing on stereoscopic space of traffic hub, so the diving on information levels is very important.

3 Building Space Coordinated with Signage System Shall Form up a Population Guiding Method of "Pipe Type"

The space in comprehensive traffic hub is very steric, with complicated function on function of each floor. So the connection spots and crossing spots in steric space of station are the most complicated aspects. For example, there are a lot of metro lines, taxi areas, bus areas, warehouses and so on under the traffic hub.

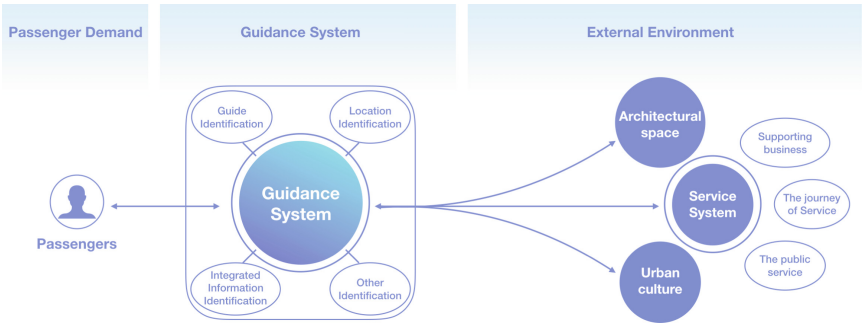

Fig. 1. Influencing elements on designing signage signs system

The designing shall be based on passenger demands, pipe type transiting method would well improve the efficiency of signage system, in this way to improve passengers' experience. Just like the assembly line in factory, the nodes and paths are designed according to passenger demands. Designs in this way could not improve passenger's experience during their travel, and the management difficulties for station could be well reduced.

4 Relationship Between Building Structure and Signage Designs

Content of this part is mainly expounding from the aspect of special features on traffic hub space. Figure 2 is showing the observation principle of signage design, among which every process could be possibly disturbed because of all types of environmental elements.

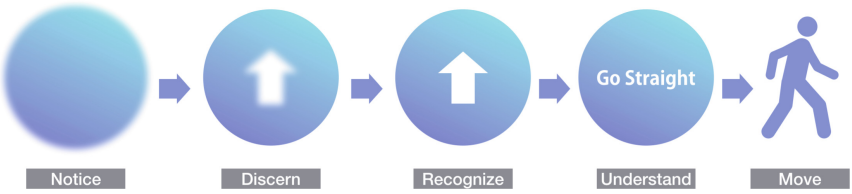

Fig. 2. Observation principle of signage information

4.1 Take Full Advantage of Building Height

Which the functional demands from different height have to be balanced, and the information on same level has to be unified. Only in this way can the problem of information mixing could be avoided. By taking advantage of building height, boards

with different information type could be divided into different levels and height. The detailed advice is to place all large sized advertising boards and train number information boards at the highest place of the hall, the middle height spaces with plane sight are for signage information of path guiding, the rest lower spaces are for other location signs, advertising titles and other information.

4.2 Reasonable Levels and Areas for Building Function

Reasonable building function levels and areas can easily evacuate crowds, so the population could be divided. It would also be good for pipe type guiding. A lot of domestic stations are suffering the problem of mixing population because of unreasonable levels and areas dividing, which make the major functions overlapped. On this aspect, most airports are better than high-speed railway stations.

4.3 Mutual Trust System at Inlets and Outlets to Improve Transmitting Efficiency

Inlet and outlet of traffic hub are in a lot of types. If the arrived passengers via other means of transportation are already examined by security system, and the whole process is sealed, so the process of security check entering high speed railway station is useless and can be reduced. By reducing which, the population crowd could be well remitted.

4.4 Arrange the Signage Signs by Taking Advantage of Building Structure

There are a mess of stairs, rolling stairs, elevators, pillars, air conditioning outlets, beams and so on in traffic hub buildings. Such items would sometimes block the line of sight, so there shall be more signage signs in such spaces. So some of the signage boards could use these structures, while the relation of levels shall be concerned as well.

5 Relation Between Guiding Design and Built Environment

Among the built environment, the most important influencing environment element is lighting. Both natural light and artificial light sources are for the aim of lighting up the areas which we care about. Guiding board is a part of the environment, the design on which has to conform to the environmental features nearby as well. Weakness of lights would influence the brightness of signs, pureness of colors, and the contrast of sign against environmental color. So on designing of guidance system, based on different colors, material and craftsmanship, there would be different visual effects.

5.1 The Influencing Relationship Between Guiding Board and Light of Built Environment at Day Time

At day time, the influence of natural light in built environment shall be concerned. Problem of light reflecting would be quite outstanding at the inlet and outlet of building structure, as most inlets and outlets are constructed by large sized glass screen door. With this situation, the guidance board shall be equipped with light box, so the guidance board could light up itself. The problem of backlighting and not outstanding on guidance board could also be solved with this idea, the material and color of appearance shall also be concerned.

5.2 The Influencing Relationship Between Guiding Board and Light of Built Environment at Night

According to the investigation against a lot of stations, there appears a lot of problems on guidance board at night. The advertising boards are too bright which impacts guidance boards, the safety warning signs are not treated with light reflecting, guidance signs are not lighted or the light box is damaged which makes the guidance information is half-baked, or missed. During the designing on signage system, whether to select back light source or side light source, how to control the degree of light source, all such aspects shall be decided by elements including sizes, colors, brightness and so on of the words, as well as the color changes of signs with lights, changes of brightness and image back. As a general rule, the brighter the light is, and the more distant the visual distance is, the wider the visual sight would be. White color shares the biggest view sight.

6 Summary

Figure 3 is displaying the summary of guiding design process against comprehensive passenger traffic hub. Any environment shall put people first, only in this way could the final displaying performance bring the best experience for passengers. At present, except for the influencing element of built environment, commercial element is an important impact as well. The major point is still to start from customer demands, to balance commercial elements in a systematic methods. In this way, when passengers have good experience, commercial benefit could be maximized as well. And for traffic hub, all service facilities can make the best sense.

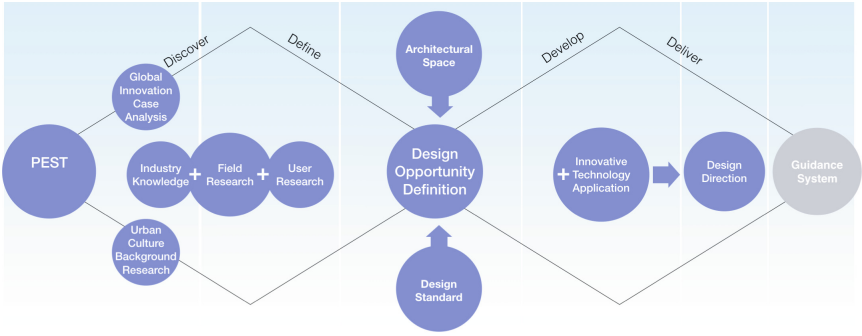

Fig. 3. Soviet and American moon landing suits

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Songkram River Basin: Floating Vernacular Architecture

Sarawuth Pintong(✉)

Faculty of Decorative Arts, Silpakorn University, Bangkok 10200, Thailand
md@triz-consultant.co.th

Abstract. Songkram river basin is located in the Upper North Eastern of Thailand (so called Isan). As a part of the 4 factors, one of the vernacular architecture of Songkram river basin, "Pae Sadung Yak", the unique local fishery raft that strongly shown the sense of simplicity and wisdom. This research extract new design concept of vernacular architecture which will transform this bamboo fishing raft into the new application as a floating resort. The results of this research are not only preserving the intangible heritage local wisdom of this particular "Rock Salt", but also the creation of circular economy which could elevate the wealthier status of the people in the area and attract people from different cultures such as the outsider or tourists and lead them to experience the new "Isan lifestyle" which handcrafted design for sustainable tourism.

Keywords: Circular economy · Four factors · Songkram river basin rock salt · Sustainable · Tourism · Vernacular architecture

1 Introduction

Apart of an abundance landscape along its length of 420 km, there are two essential elements that lead to the earliest settlement in the area of Songkram river basin, which are "salt" and "fish". According to the archaeology findings and also from the local people, there has been a very long history of Rock salt trading between "Bo Huahead" (Rhino head), the ancient rock salt well in Songkram river basin with other communities in Mekong region such as people in Laos and Cambodia. Rock salt and fermented fish which are the common food culture in South East Asia were produced locally and being traded with other goods for more than 400 years. The intangible heritage local wisdom of finding and producing this rock salt has been continually passed on from generation to generations. However, this knowledge is fading away due to the economic of the salt boiler people or "Khon Tom Klear" who currently surrounded with problems. The selling price of this salt is incredibly cheap when compared with its both history and quality. While the living expenses are increased, which is the reason why there will be no newer generation to heir this knowledge in the near future.

Due to the aims of this research is not only about finding the way to preserved this intangible heritage local wisdom, but also to elevate the wealthier status of the people in the area with circular economy. Thus after primary and secondary research, the

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"Isan Salt Route" project has been introduced to the Ministry of Culture, Ministry of Foreign Affairs, and especially, Tourism Authority of Thailand. With the aim of growing awareness of losing this valuable knowledge to the related stakeholders. The concept of this project is to research through the rock salt and its surrounding contexts that related to the 4 factors, which are, gastronomy, fashion, cultural landscape, and arts. Then divided into 3 phases which are growing awareness phase, developing products and services phase and a knowledge explosion phase.

Thus, the objective of this article is a part of the 2 phase, "Pae Sadung Yak" the floating vernacular architecture of Songkram river basin which is the unique local fishery raft that represent the sense of simplicity and wisdom that reflected the relationship between people and their cultural landscape. Even though, its shape and form is definitely attracted to the people who see it, but however, it is need to be redesigned in order to serve the new function as a floating resort for the visitors (Fig. 1).

Fig. 1. Picture of the Songkram river basin: The floating vernacular architecture.

2 Literature Review

As mentioned, there are many literatures that related to Songkram river basin. Mostly are in the areas of archeology, sociology, geology and fresh water fishery. However, what could be concluded in the area of Songkram river basin is comprised of a number of different wetlands that derived from in-basin and the Mekong river that forming one extensive lowland floodplain system. The wetlands are unique in many ways, not only because of the dramatic Mekong-influenced floods which turn the floodplain into one massive shallow lake system each rainy season, but also because of the high value of livelihood services and ecological functions, the wetlands offer local communities that harvest the biodiversity resources for income and substance needs [1].

Moreover, in terms of Vernacular architecture, "Toop" which is a temporary building that used for boiling saline water and producing salt is usually mentioned in

terms of its wisdom. Due to the location of Bo Huahead which is located in the floodplain and the water level is really high, so every year the salt producer have to fixed their toop before starting the new season of salt production. However, in regards with the floating vernacular architecture, the fishery raft that used to do fresh water fishery throughout a year for household consumption, seems to be common and not being mentioned.

3 Design Methodology

The research methodology of "Pae Sadung Yak" the floating vernacular architecture of Songkram river basin is framed to investigate throughout all of the related issues such as architectural form, functions, materials, construction technique and its surrounding context. Then all collected data will be analysed together with the participation of local people in order to summarised and used as a design program. The new design will be combined with the new application of usage that conform to the activities of the visitors which will be taking place on this floating vernacular architecture in order to provide the empirical experience of both, the new Isan lifestyle and the way of life in Songkram river basin.

4 The New Design of "Pae Sadung Yak" of Songkram River Basin

The fundamental of vernacular architecture is to improve the limitation and the relationship between people and their context. Same as "Pae Sadung Yak" that originally design to respond to the way of living in Songkram river basin where the water level is totally different between dry season and wet season. In addition, there is a the mass number of the upstream fish migration from Mekong river in every flooding season [2], which is a reason why the local people create a square lift net on a bamboo raft and a small utilities space on the other side. With this local wisdom, the raft can go anywhere in any season.

Thus, to redesign the new floating architecture, researcher started with the new floor plan because some facilities such as bedroom, living area, kitchen, shower room, and toilet are need to be added on. In terms of the architectural form and materials, bamboo, a local material is being used in different area such as round raft, plaited bamboo partitioned, and the lift net structure as well. Moreover, the researcher has also selected the hand craft local products such as reed mat and traditional textiles to decorate in some area. In terms of activities, the outdoor terrace is placed in the centre of the raft in order to provide the utilities space that can support the multipurpose of usage (Figs. 2, 3 and 4).

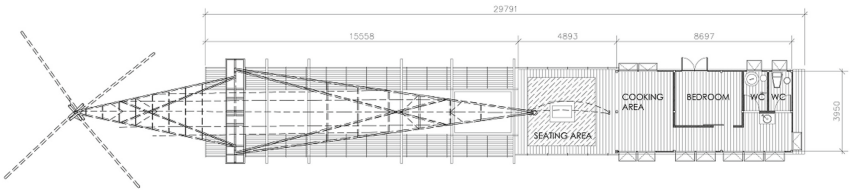

Fig. 2. Picture of the new floor plan of the floating vernacular architecture.

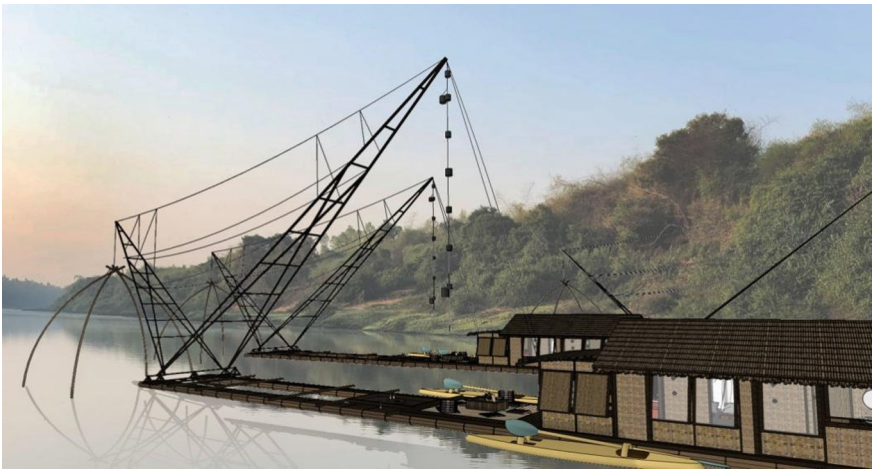

Fig. 3. Picture of the new floating resort: the view from Songkram river.

Fig. 4. Picture of the new perspective of circular economy: Experiencing Isan lifestyle.

5 Conclusion

The vernacular architecture is the architecture of truth because it is created in order to serve its owner way of life. All related issues are the reasoned of its shape, form, space, function, and proportion. Thus, in order to regenerate the new use of some particular architecture, architect or designers should take all related contexts that surrounded the architecture itself into consideration. In addition, the participatory of the local people always important because they have been living their life with their vernacular architecture for longtime, which is mean that they can provide some useful information for the design object accordingly.

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Architecture and Urban Planning

Improvement of Public Transport Routes with ArcGIS Network Analyst. Case Study: Urban Center of Milagro, Ecuador

Freddy René Orozco Amaguaya(✉)
and Jesús Rafael Hechavarría Hernández

Facultad de Arquitectura y Urbanismo, Universidad Estatal de Guayaquil, Cdla. Salvador Allende Av. Delta y Av. Kennedy, Guayaquil, Ecuador
{freddy.orozcoam, jesus.hechavarriah}@ug.edu.ec

Abstract. Public transport plays an important role in big cities. Taking into account that the population is constantly increasing, it is important to analyze this issue and make decisions based on the optimization of routes and the improvement of the public transport service. At present, from the perspective of travelers there are many alternatives (modes of transport) to move within a city. The choice of mode can be based on many criteria, such as: costs, comfort, distance, travel times, security, among others. Around this issue, many cities opt for development plans that include efficient public transport strategies, with low environmental impacts and that are attractive to users. In this context, this article aims to address an analysis methodology to improve public transport routes and propose alternatives that improve their performance. The study is developed for urban transport routes in the urban area of the city of Milagro in Ecuador. As a computer tool, the ArcGIS Network Analyst is used to enhance the decision-making process in the selection of transport routes.

Keywords: Public transport · Route optimization · Network Analyst

1 Introduction

The importance of cities to have efficient public transport circuits is undoubtedly yearning for every city. Basically, because most of the investment of countries is produced in cities, that is why it is important to implement urban transport infrastructure and services to solve mobility difficulties.

In several cities in the world, the urban public transport system is essential due to the notable demographic and economic increase that is taking place, so it has been decided to implement integrated transport systems such as: articulated buses, trains, pedestrian paths, bicycles, which involves investments of money that many cities may not hold. The maintenance operations of the transport infrastructure in turn entail a large investment to keep in optimal conditions, a complementary alternative to this would be the optimization of the mobility resources available to the city.

The use of strategies to improve the decision-making process in urban planning is of interest in recent years [1–3]. Other research devotes efforts to the analysis of urban

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transport and access roads [4, 5]. In this study, the different techniques used for operations research have been applied to determine the improvement of public transport routes in the city of Milagro. The applied techniques allow to determine better fluency and the improvement of routes for the route of buses in the urban area. This case we have addressed has been fragmented into two stages for resolution, one that consists of the location and another in the vehicular routing of bus routes. Based on these references, proposals for bus route improvement will be developed using correlation of variables to define a road corridor that optimizes existing routes and defines new complementary routes to the existing transport system.

Public passenger transport must have a response that meets the needs of users, so it is necessary to make adjustments to the infrastructure of the city with the determination to reduce the distances between origins and destinations of each trip. Optimization has been applied to multiple transportation-related problems with is the number of vehicles that allows to program an optimal number of routes from the stops and the demand in each one of them [6–8]. On the other hand, in the optimization of trajectories multiple algorithms have been used such as: Dijkstra, Bellman-Ford, Johnson, Suurballe, among others [9].

2 Public Transport in Milagro

Our case study focuses on the City of Milagro, the main urban road structuring was the railroad, which gave way to Garcia Moreno Street. This road crosses from west to east to the city and it is on this road that the other structuring roads that leave and enter the city converge, giving it its particular star shape. This is one of the reasons why most of the long non-structuring roads tend towards the central area of the city. The other great reason, is the historical tendency of the mobility of people, of always looking to move towards the center of the city (in search of satisfying their needs), so that when a land was going to urbanize, the road structure is framed in this regard.

The central area of the city of Milagro, has an anachronistic road system. Like most cities in the country, the road space responds to a dynamic of the early and mid-twentieth century, but that from 1970, with the large population of urban and urban centers, the road space was not very functional and in many cases of difficult accessibility especially for pedestrians.

Most of the roads in the central zone, do not keep symmetry between sidewalks, are relatively narrow, do not have adequate turning radius for a certain type of transport that circulates (such as the urban one), its sidewalks are narrow in relation to the activities that are developed in them and the demand generated by these activities. In addition, the pedestrian circulation space (sidewalks and arcades) have many slopes, without adequate ramps, and in many cases, their floors are covered with sliding ceramics. The public transport system in the city of Milagro is the result of the urbanization process and historical mobility trends. However, although it was a result of both factors, it is also true that it supports the current displacement conditions. See Fig. 1.

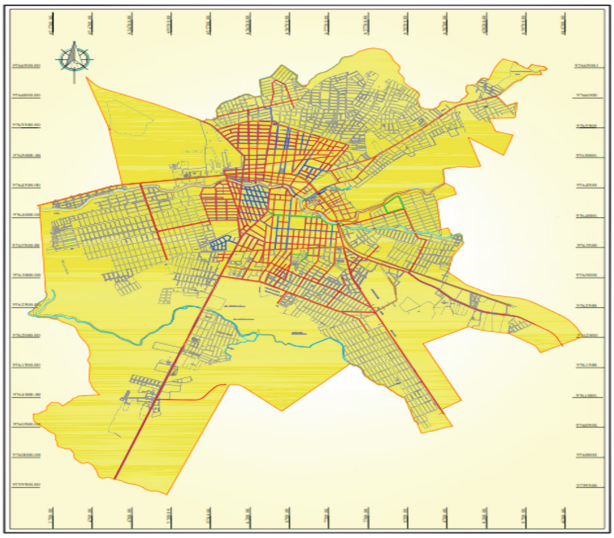

Fig. 1. Map of the existing transport routes in the City of Milagro

3 Methodology

The methodology that will be used in the study of a passenger transport route is based on ArcGis Network Analyst. Initially, the different current routes of destination origin that make up the city of Milagro must be identified. Additionally, the city must be built with the attributes that correspond to each road (permitted speed, passage restrictions, senses, etc.), this information must be complemented with the traffic light crossings existing. Once the geographical and network identification of the area of analysis has been made, the construction and evaluation of the routes mobilized is carried out, using information on the trips generated in the area according to the analysis of destination origin. For the creation of the network dataset that allows modeling the transport network, nodes are located at each of the intersections of the roads. The transport network is configured with the necessary evaluation functions to assimilate the direction. Additionally, the Dataset allows the configuration of attributes such as maximum speed allowed on roads, traffic lights, prohibited crossings, closed streets, among other factors that may affect the model's result. For the present study was considered 10 routes that run through the urban area and have a travel distance of 5500 m in the city, see Fig. 2.

The study of routes aims to make a comparison between the routes currently operating and the route drawn by the optimization algorithm that Network Analyst implements. In this phase a comparison is made using the destination origin matrix that indicates the number of passengers that are transported from one sector to another, travel times and other factors that indicate an improvement to the current route in the

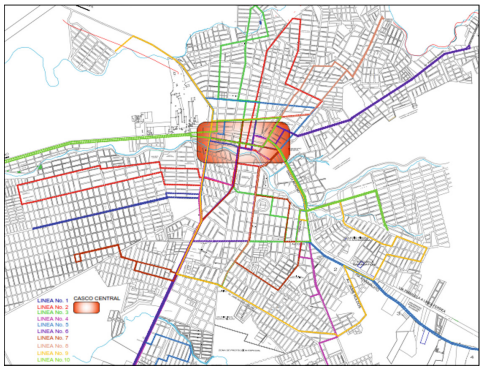

Fig. 2. Urban transport routes that circulate in the urban area of the City of Milagro

urban area. Finally, the results of the comparative analysis between the routes and the aspects that were improved using Network Analyst are shown, resulting in a single route circuit that the buses would carry out in the urban area, resulting in decongestion, fast circuit route, fluid and Especially optimal.

4 Route Analysis

The attributes of the network provide basic elements such as the distance of each section of road, the directionality of the streets (one way or double direction) and the level of hierarchy (highway, arterial, local road). To take the best route, distance is taken as impedance. The main nodes for the route analysis are identified starting with the node one or start node, an end node and several nodes to be scanned where the minimum stops or nodes reached by the route are indicated. In total, the necessary nodes are defined, forcing the route model to cross through the zones of destination origin as mandatory control points and which are initially covered by the initial route, see Fig. 3.

Fig. 3. Identification of nodes

Once the nodes are selected, a solution is given, generating a single route circuit in the urban area in which the 10 existing routes would be incorporated into this optimal circuit with a distance of 4950 m, which manages to cover all the urban sectors of the Canton Milagro, see Fig. 4.

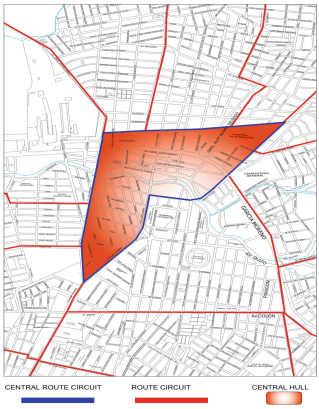

Fig. 4. Proposed circuit

A comparison will be made with the results of the two routes (original routes vs. optimized route) calculating the travel times for each section with an average speed between 20 km/h and 30 km/h. It will be possible to show a saving in terms of distance and travel time of approximately 17%, in addition to the buses would not circulate through the urban area but by an optimal route giving greater fluidity to the city center.

5 Conclusions

In the development of this work the potential of GIS to analyze transport networks in urban settings can be verified. Its use can also facilitate the integration of spatial and geostatistical analyzes that have been ignored in many logistics models and with which decision making in this field would be improved. To take the best route, distance is taken as impedance. The proposed method from the use of Network Analyst allowed to integrate multiple objectives in the solution model such as the number of potential users in the optimal route, speed, travel times and distances. This integration facilitates the comparison of multiple criteria to evaluate the efficiency of the route obtained in relation to the transport routes currently being carried out.

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Proposal for a Master Plan of Green Area in the Second Step of the El Recreo Citadel, Canton Duran, Ecuador

Gilson Arreaga(✉), Gabriela Vega, and Jesús Rafael Hechavarría Hernández

Faculty of Architecture and Urbanism, University of Guayaquil, Cdla. Salvador Allende, Av. Delta y Av. Kennedy, Guayaquil, Ecuador
{gilson.arreagama, gabriela.vegag, jesus.hechavarriah}@ug.edu.ec

Abstract. As a result of the disorderly population growth that Durán has had, in the province of Guayas, the urban green index of 1,22 m^2/inhabitant is below that established by the World Health Organization. This value is even lower in the study area in the second stage of El Recreo with a value of 0.30 m^2/inhabitant. This generates heat islands in urban areas that cause impoverished air quality, a decrease in the quality of people' lives and a high demand for energy in order to achieve thermal comfort when air-conditioning residential spaces. For the proposal, a pedestrian street was selected as a model to be replicated in the others. The objective is to propose a master plan for green areas to mitigate the high temperatures recorded in the second stage of the El Recreo citadel, Durán, in order to create microclimates to contribute to the fulfilment of Ecuador's sustainable development objectives.

Keywords: Urban heat island · Urban green indicator · Air quality · Green areas · Ecosystem connectivity

1 Introduction

The deficiency of green areas is a problem of great relevance in the world, thanks to the high concentration of people in urban areas. Tree planting is of extreme importance because it has many benefits; the most important are to cool the cities of the high temperatures, to clean the air because 92% of the world population is in cities where the quality of the air is low [1], in addition that is recommended that each city has a minimum of 9 square meters of green areas per inhabitant [2].

The urban structure of the Citadel of El Recreo is constituted by 2 main roads connected by walking streets for the access of the residents to their homes. In the second stage of El Recreo, as well as in the other stages, the urban heat islands (ICU) are a potential problem due to the replacement of green areas by concrete in the walking streets, in addition of the existence of 1 park whose use is mainly sports and only has palms that don't give adequate protection from solar radiation.

Other problems that affect the second stage of El Recreo are the informal neighborhoods located across the street that were built at the same time as the construction of

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the citadel [3], causing unplanned demographic increase and, combined with scarce urban planning, the canton of Durán has an urban green index (UVI) of 1.22 m^2/inhabitant. [4] and in the second stage, this is 0.30 m^3/hab.

The objective of this work is to propose a master plan for green areas as a strategy for ecosystem connectivity, heat island reduction and increase of the urban green index in the second stage of the citadel of El Recreo, canton Duran, Ecuador. To achieve this, the physical characteristics of the pedestrian streets that make up the second stage will be determined, in addition to measuring the average temperature of the different areas of the second stage to determine in which of them the heat island effect is generated and to make an inventory of the existing vegetation coverage.

It is important to mention that green spaces in cities help to reduce the effects caused by the ICU and also give comfort to the occupants near them [5] so that the population growth in cities is the cause of the change in the use of the land and the suppression of the green infrastructure produces the loss of beneficial ecosystem services [6].

The ICU can be defined as a local greenhouse effect, as the gases are confined to one place causing a capsule to absorb heat from the sun [7]. The materials that compose the city absorb short-wave solar radiation and then reflect it at a longer wavelength, which is retained by combustion gases and suspended particles [8].

Las ciudades tienen una alta relevancia en el cambio climático, Según el Center for The cities have a high relevance in the climate change,

According to the Center for Human Settlements (UN-HABITAT), the cities emit 80% of greenhouse gases (GHG) in addition to consuming 75% of the world's energy. In other words, urbanized areas are directly responsible the climate change for two factors: the contribution of GHGs and the radiation caused by the urbanized land, which reduces the level of humidity in the environment [9].

This increase of temperature in the urban area is directly associated with human thermal comfort in which people generally feel more stress due to heat, in addition to the increase in energy demand to cool the building and the reduction in the quality of life of the residents [10].

2 Materials

The citadel El Recreo, located in the parish of the same name is in the southeastern sector of the canton Durán, province of Guayas.

It has an altitude of 5 m over the sea level (msnm), the second stage has a latitude of −2.177932° and a longitude of −79.809496°. With respect to the climate, it is in a warm climatic zone, that includes from the dry subtropical to the humid tropical, with an average temperature of 25 °C. At 30 °C., with winds from the SW at 10 km/h and a humidity of 78%.

The Citadel El Recreo was created during the administration of the then president of the Republic of Ecuador, Ab. Abdalá Bucaram, first as a housing plan program called "Un Solo Toque" (1996), in charge of the Ecuadorian Housing Bank, was divided into five stages [11], which were built with brick and cement, one floor each, these lots had a dimension of 12 m long × 6 m wide. The population of the second stage is about 12,000 habitants.

3 Methodology

For the methodological process of this research, three techniques were used; observation, use of instruments and a questionnaire. In relation to observation, a tour of all the pedestrian streets was made to determine the number, dimensions and physical characteristics of the streets.

At the end of the tour it was determined that there are 50 walking streets and that all the green areas of 3 m wide originally delivered when the Citadel El Recreo was built have been substituted by pavement for the parking of vehicles, an action that doesn't fall within the law since these are not allowed for vehicles because they were created for pedestrian traffic.

With respect to the rainwater system, it doesn't exist neither roadside ditches nor gutters for the drainage of the water so that in the rainy period the water accumulates due to the pool effect.

The lighting at night is deficient due to approximately 40% of the lights burnt out and the electrical cables are a problem for the existing trees (Fig. 1).

Fig. 1. Typical section of existent walking street. Source: Own elaboration.

With the help of a biologist, the inventory of the existing vegetation was made, detailing the general name, the scientific name, the state in which they are found and the number of existing trees (Table 1).

Table 1. Inventory of existing trees in the second stage

General name	Scientific name	Condition	Quantity
Almond tree	*Prunus dulcis*	Good	9
Mango tree	*Mangifera indica*	Good	10
Ficus	*Ficus benjamina*	Bad	1
Papaya	*Carica papaya*	Good	7
Norfolk Pine	*Araucaria excelsa*	Bad	1
Zebra tree	*Erythrina indica picta*	Bad	1
Fan Cypress	*Thuja orientalis*	Good	2
Australian Royal Palm	*Archontoplhoenix Alexandrae*	Good	10
Total			**41**

Given that all the walking streets are formed by a section of 6 m length of 144 m and are in a similar physical state, the measurement of the temperature was done in the street located between blocks 238 and 239 at the beginning, in the middle and at the end with a distance of 72 m. between them.

This measurement was made with a digital thermograph brand Pro'skit for 15 days in a row from Monday, January 6 to Monday, January 20 every 3 h from 6:00 am to 9:00 pm (Table 2).

Table 2. List of temperatures (T^a) taken in the walking street between blocks 238 and 239.

Day	T^a - 6:00	T^a - 9:00	T^a - 12:00	T^a - 15:00	T^a - 18:00	T^a - 21:00
06-01-2020	26 °C	25 °C	25 °C	29 °C	30 °C	32 °C
07-01-2020	25 °C	25 °C	25 °C	27 °C	29 °C	30 °C
08-01-2020	26 °C	25 °C	25 °C	30 °C	32 °C	31 °C
09-01-2020	25 °C	25 °C	25 °C	28 °C	32 °C	34 °C
10-01-2020	26 °C	25 °C	26 °C	30 °C	33 °C	34 °C
11-01-2020	26 °C	26 °C	25 °C	26 °C	32 °C	33 °C
12-01-2020	25 °C	25 °C	25 °C	27 °C	30 °C	32 °C
13-01-2020	27 °C	26 °C	25 °C	30 °C	31 °C	32 °C
14-01-2020	26 °C	26 °C	26 °C	30 °C	32 °C	34 °C
15-01-2020	27 °C	26 °C	26 °C	29 °C	30 °C	31 °C
16-01-2020	26 °C	25 °C	25 °C	28 °C	30 °C	32 °C
17-01-2020	27 °C	26 °C	26 °C	28 °C	30 °C	33 °C
18-01-2020	27 °C	26 °C	27 °C	31 °C	32 °C	32 °C
19-01-2020	27 °C	26 °C	27 °C	32 °C	32 °C	33 °C
20-01-2020	26 °C	26 °C	25 °C	31 °C	34 °C	35 °C

For the survey a questionnaire was made with the following questions: What is your age? what is your sex? How would you describe the current state of the walking street in front of your house? Do you have a vehicle? Do you consider that the

temperature in your sector is high? If the answer to the previous question was yes, what do you think is the reason for this phenomenon? What electrical device do you use to lower the temperature in your house? Would you agree with the recovery of the green area that has been paved for the parking of vehicles? If the answer to the previous question was affirmative, would you be willing to participate in the planting of trees, to take care of and maintain in good condition the green area to be recovered?

The survey was performed on 117 people, and it was obtained with QuestionPro using a confidence level of 95%, a margin of error of 9% and a population of 12,000 people.

4 Proposal

The proposal of the master plan of green areas is composed of two points. The first consists of the recovery of the 3 m of green area that was paved, in this area of 432 m^2 (144 m × 3 m) is proposed to plant trees and green area.

The planting distance between trees is about 3 m to 4 m depending on the particularity of the tree, of different species to avoid the death of the tree in case of plague, as in addition to a maximum height of 6 m and a maximum crown of 5 m. The number of trees proposed is approximately 2100 units and these have to satisfy the following characteristics:

- Endemic species
- Perennials
- Low watering
- Deep Roots

With respect to the green area, it must be able to support the traffic of people and have a low maintenance level. In additional, a gutter on each side of the green area is proposed to drain off the rainwater, which would be connected to the gutter located on the main road. It is also proposed to replace the light pillars with lights that use solar energy (Fig. 2).

Fig. 2. Proposed typical walking street section. Source: Own elaboration.

The second point of the proposal is the optional use of green walls on the faces of the houses to help reduce the temperature and alleviate the urban heat island thanks to the shade caused by the vegetation [12]. About the technique to be used for the implementation of this system because it is not obligatory, the owner of the house will be able to choose the best option in economic terms and maintenance.

5 Results

With the proposal to recover the green areas in the 50 walking streets, it results in the incorporation of 21600 m^2 of green areas to the 3200 m^2 of the existing park in the second stage.

The presence of trees in the stage is poor and your variety is mainly fruit, the fruits are not used by the community and are seen as a danger to the parked cars. The trees are mainly found in temporary planters and the condition of the trees is mostly good.

With the results obtained through the survey, it was possible to determine whether the inhabitants of the second stage agree with the recovery of the green area, including the owners of the vehicles who agreed to park them in the existing parking lots on the main road in order to improve their quality of life and for the incorporation of the green walls in their facades. The owners requested technical training from the municipality of Durán or the Ministry of the Environment to plant them on their own.

6 Conclusions

With the green areas obtained, the urban green index increases from 0,30 m^2/hab to 2,10 m^2/hab, which is still below the WHO recommendation of 9 m^2/hab. But with the inclusion of green walls, the objective of mitigating the urban heat island is met, a phenomenon that was found to exist in the second stage of the El Recreo citadel with the use of a digital thermograph, since the temperature increases mainly at night. By incorporating trees of different species, the required ecosystem connectivity is created, because with the union of these, green corridors are created in each walking street, which also attracts different species of birds, insects, fungi, among others. Furthermore, this green infrastructure improves the urban landscape, which generates comfort and well-being for the community.

7 Recommendations

In addition to green walls, the use of green terraces is recommended only when the houses have concrete slabs and for sloping roofs we suggest replacing them with sandwich type roofs for thermal insulation.

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Proposed Strategic Plan to Delimit the Historic Center of Babahoyo. A Case Study in Los Rios Province, Ecuador

Raul Icaza(✉) and Jesús Hechavarria(✉)

Faculty of Architecture and Urbanism, University of Guayaquil. Cdla. Salvador Allende, Av. Delta y Av. Kennedy, Guayaquil, Ecuador
{raul.icazamu, jesus.hechavarriah}@ug.edu.ec

Abstract. Informal settlements that were created on the banks of the Babahoyo River in the province of Los Ríos have become architectural elements of cultural identity in Ecuador. However, this heritage has been affected over the years due to multiple causes which has resulted in a notable exclusion of basic services and the decrease of cultural identity spaces in the urban development of Babahoyo. In the present work a strategic plan with cultural identity is proposed to delimit the historic center of Babahoyo. The proposal considers the renovation of traditional public spaces through prospective methodologies that relate tangible, intangible factors, natural or man-made elements as well as the forms and practices of public space with the objective of contributing to the renewal of the urban image of the city and boost local tourism.

Keywords: Culture · Urban planning · Development · Heritage · History

1 Introduction

The image of a city is included within the main elements in the development of modern cities; however, it loses its meaning when it is only proposed to improve its aesthetics by following stereotypes of culture and creativity [1] similar to other large cities, trying to strengthen the levels of economy, security and giving it a modernization character, leaving aside strong characteristics of space as It is the culture, its history and the relationship between these two elements and the inhabitants of the city intervened.

Informal settlements that were created on the banks of the Babahoyo river as time has passed have become architectural elements of cultural identity [2] for the inhabitants of that city, however the disinterest for the conservation of these houses and the notable exclusion towards the inhabitants of these homes in terms of the provision of basic services have had an impact on the decrease of cultural identity spaces in the urban development of Babahoyo, resulting in the deterioration of these homes to the point of being under threat and their imminent disappearance.

Added to this is the accumulation of solid wastes, health problems and the proliferation of diseases due to the lack of an efficient sanitary drainage system, the increase in the poverty and delinquency index, which leads to the gentrification and relocation of affected families to Housing projects that in some cases not only do not

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end up being a solution, but also help increase the problem that already exists. In 2011, UNESCO gave as a Recommendation in relation to the historical urban landscape to propose the application of a comprehensive Inclusive approach that supports communities recognizing the borders of the plurality and diversity of urban heritage and its capacity for continuity and change in the weather [3].

Therefore, it is not excessive to say that urban identity is the means of representation of the natural, cultural and artificial components of cities [4]. Through the concept of the identity of the place it is debated that individual and collective identity and has caused specific psychological, social and political effects [5].

2 Materials and Methods

2.1 Delimitation of the Study Area

Babahoyo is located at 1° 48′07″ south latitude, 79° 32′03″ west latitude 10 meters above sea level and with an extension of 174.6 km^2, capital of the province of Los Ríos, name that has been granted thanks to its water network that is made up of 379 rivers, streams and estuaries that irrigate it. According to the 2010 census, the population was 153,776 inhabitants [6], has a humid tropical climate and with dry periods between the months of June to December, with average annual temperatures of 25° to 27 °C [7].

2.2 Case Study

Being a global study that would directly and indirectly affect the inhabitants of the city of Babahoyo in both the urban and rural sectors; sampling throughout the canton with various instruments such as surveys of inhabitants of different ages, social-economic stratum, level of intrusion with which we would obtain data that would determine the level of appropriation of public space and the spaces with which They feel culturally and historically identified.

Likewise, interviews were conducted with people who lived and who still live in the different floating homes that still exist on the banks of the Babahoyo River in both the parishes Barreiro, El Salto and Camilo Ponce, so that the degree of social complexity can be assessed that exists with respect to the exclusion of which these people are parties. Making a Spoken Mapping in inhabitants of various ages and from different sectors of the canton based on the processes and major changes that this canton has undergone from the political, social, infrastructure and urban planning to identify which are the elements of greater cultural capture and historical that you have persisted to these changes in a period of approximately 50 years.

2.3 Identification of Historical Settlements

The identification of the sectors in which there are historical buildings will be carried out by means of a visit and field trip and their evaluation through the construction of an analytical route to evaluate the relevance of an intervention to the historical heritage [7].

2.4 Construction of the Thematic Indicators and Their Association

Making a mapping that according to Ziyaee must be done by analyzing the forms through providing intangible factors of cultural landscapes with which a balance between natural elements and those cultural elements that provide an identification to the sector to intervene is achieved [4]. Considering an appropriate and feasible analysis for a specific zoning and definition of the historic center, facing the knowledge acquired in terms of data exploration and the construction, estimation and georeferencing of physical, architectural and Socio/economic data [8].

2.5 Selection of Scenario of Intervention

When developing an analytical route to identify the level of weighting of the indicators through an exploratory study, surveys and interviews were carried out in the different points to intervene, in order to elaborate an inventory of the relevant and representative elements (Table 1), through a comparative chart between the built scenarios with their accessibility (Table 2), the physical-architectural intervention and the socioeconomic characteristics according to the local context [8].

Table 1. Inventory of historic buildings.

Name	Building time	State
Flouting houses (rafts)	XX century	Bad
Governorate municipality	1978	Good
Olmedo's Hause	XVII century	Regular
Cathedral Church	1954	Good

Table 2. Inventory of areas to intervene

Name	Location of the architectural element	Accessibility
Flouting houses (rafts)	Rio Malecon	Difficult
Governorate municipality	Main urban roads	Easy
Olmedo's House	La Virginia Sector	Moderate
Cathedral Church	Central Park	Easy

Table 3 identified the relationship between the pre-selected architectural elements with the inhabitants of the sector and their environment, where (+) defines a positive correlation, (–) a negative correlation and (*) an intermediate correlation.

Analyzing the main components (Table 1) with their urban context, new indicators emerge that will identify the peculiarities of the built heritage, to finally have an estimate of values proportional to the intervention on the buildings and developed in different variants, such as the production and evaluation of different scenarios with different transformation coefficients of the existing ones In addition to the study of the

Table 3. Level of interaction of the architectural element with its inhabitants and its context

Name	Relationship with its inhabitants	Relationship with your connection
Flouting houses (rafts)	(–)	(–)
Governorate municipality	(*)	(*)
Olmedo's House	(*)	(+)
Cathedral Church	(+)	(+)

correlations between the main historical architectural and cultural elements, its inhabitants and the surrounding context, a survey was carried out, which was designed for the inhabitants of the urban area of the Babahoyo canton, including the urban parishes of Clemente Baquerizo, Camilo Ponce, El Salto and Barreiro, which sought to identify the indicators of correlation by age range and their cultural perception of the representative spaces of the city.

3 Proposal

The proposal focuses on the connection of the architectural elements with cultural identity mentioned above through the intervention, adaptation and potentiation of each of these elements so that the gap in the contrast between the public space already intervened and the ancient buildings decrease, thus achieving greater inclusion of those people who inhabit these spaces in the society. The connection to be implemented would be given through the use and appropriation of public spaces such as roads, sidewalks, parks, civic plazas and forested areas, implementing green corridors seeking to be a planning tool and guide for decision makers within what areas should Prioritize and follow up on issues of conservation, reforestation or environmental education.

4 Results

With the review of the results obtained in the survey, it has been possible to define several factors regarding the connotation of the historical elements, such is the case of the Casa de Olmedo as the main element of historical representation of the city and visual perception in a regular state. The selection of the appropriate scenario is not only the result of the consideration of the most characteristic socioeconomic and demographic phenomena, but it has been necessary to use an analysis of the degree of correlation between the variables and the tangible and intangible elements assumed in the analysis of the field study for the intervention, and then the verification of a possible simplification of the results in relation to specific factors [8].

5 Conclution

The study of this case denotes the need for an implementation of an urban intervention with which a connection of the historical architectural elements is achieved and the public space adjacent to each one, whether or not they were intervened for obtaining of a conceptual and sustainable matrix that represents the cultural identity of the Babahoyo canton and its inhabitants, promoting both local and external tourism.

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Validation of an Acoustic Model for Four Prototypes Sectors in Guayaquil City

Laura Calero[1(✉)], Marcial Calero[1,2], Carlos Pazmiño[1], Jesús Hechavarría[1], and Eva Vélez[1]

[1] University of Guayaquil, Cdla. Universitaria Salvador, Allende Malecón del Salado entre Av. Delta y Av. Kennedy., Guayaquil, Ecuador
[2] University Laica Vicente Rocafuerte, Av. de las Américas., Guayaquil, Ecuador
laura.calerop@ug.edu.ec, mcaleroa@ulvr.edu.ec

Abstract. The acoustic models and indicators of acceptability estimated and validated extended territorially the application of those determined in a first stage, which, evidenced that, the analysis of geo-territorial prototypes with appropriate methodologies, are pertinent to calculate the noise due to high traffic in Guayaquil. Currently, the slant to develop and applicate an acoustic ordering is based on analysis carried out for territories of small surface. A geoterritorial analysis expanded by more than 100% and the results validated the methodology and management of the variables investigated. With the analysis of more than 5000 new records, the modeling related the sound intensity, vehicular traffic, surveys and citizen perception for critical socioeconomic sectors. Statistical and probabilistic methods generated indicators with reliability between 78% to 98%, which validated the estimates in the two stages. The second stage allowed the models to be calibrated and validated and showed that the indicators can be extended to similar populations and territories with acoustic conflict.

Keywords: Calibration · Validation · Noise from vehicular traffic

1 Introduction

Guayaquil is a city of 345 km^2 with poor planning for sound quality, that generate an acoustic conflict. Diario El Comercio particularize that, the increment of traffic vehicle and the inappropriate mobility development, as well as, the definition of the new urban hubs for the public transportation and light traffic, such as vehicles and motorcycles, aggravate the problematic [1]. The actual acoustic models should be validated for wide territories in order to evidence the problematic and to resolve the conflict.

The annual increment of the urban motor cars is already the 9% [2]. The city of Guayaquil, one with the largest population in the country [3], continuously implement mobility alternatives that create sound conflicts in the urban planning because of the punctual and temporal solutions.

The research is based on the results and models published in the XI Iberoamerican Congress of Acoustic [4]. The work is part of the FCI-2017 research of the University of Guayaquil.

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The Table 1 describe the territorial context for the first and second stage of the research. The Fig. 1 describes the sectors under investigation.

Table 1. Prototypes selected for the two-research stage

Identification Code	Type of land use	Denomination of the sector	
		Stage 1	Stage 2
C.S.	Commercial	Bolivariana	Guayaquil Park
I.S.	Industrial	Mapasingue	Av. Carlos Julio Arosemena.
H.S.	Health	Child Hospital	IESS Hospital
R.S.	Residential	Kennedy	Garzota

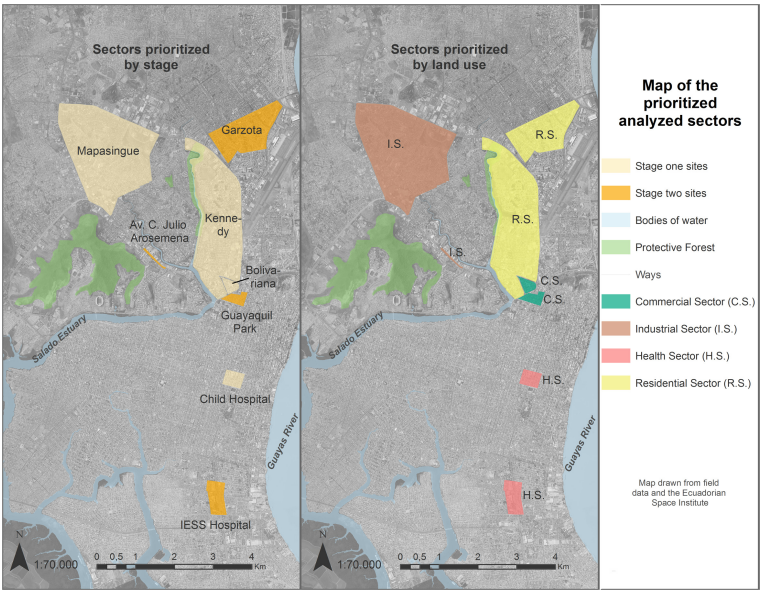

Fig. 1. Critical selected prototype sites. Source: Prepared by the authors

The work raised more than 5000 new registers and implement the interview [5] as instrument and methodology process to strengthen, consolidate and validate the research and the generated models [6].

The Republic Constitution of Ecuador manifests the good living right, but, as Gutiérrez, J. & Ibarra A. [7] points out, despite the existent conflict, the laws don't apply appropriately. The modeling, confidence indicators and intensity acoustic-traffic vehicular correlations for both territories, validate the model's application to the different sectors of Guayaquil.

2 Method

By selecting critical socioeconomic sectors, similar to those investigated at the first stage and with the expansion of the territorial sectors, data were collected and correlated with high vehicular traffic and measured and perceived sound intensity. The zones were selected by land use: Commercial (C.S.), Industrial (I.S.), Health (H.S.) and Residential (R.S.).

The register was processed and assessment with statistic and probabilistic method, and were related with the estimated models in the both stages. The resulting dimensionless indicators validate the obtained models and the application to the critical sectors, that were similar by the land use. Besides, the information of the interviews was analyzed and interpreted by means of codes and categories that sustained the quantitative results.

The analysis and registers of sound and intensity vehicular pressure, were obtained with the Ecuadorian Environmental Ministry standards [8] and the Ecuadorian Ministry of Public Work and Transport [9]. Citizen perception and interviews were based on surveys and questionnaires that approached 10 items and thematical axes related to: high traffic noise, health, psychology and payment availability.

The raised records were validated by statistic with the model:

$$\Delta_j = \frac{\sigma_j}{\sqrt{J}} \tag{1}$$

As:

Δ_j, value to correct
σ_j, standard deviation
J, record

The high noise traffic modeling was developed using frequency histograms and correlations. The assessment and relationship between citizen perceptions and noise interviews were obtained through the critical sound intensity and the threshold to the human pain [10, 11].

The validation of the relationship between the two stage models for territorial application, was carried out based on statistical functions and probability [12] and using open source programs like R and GIS. The research applied models of Kolmogorov-Smirnov [13], means comparison method, approximation by averages and Cronbach's standard deviation and alpha to obtain the dimensionless indicators that validate the models [14].

As Calero, M., Calero, L. and Andrade, M. [15] points out, the acceptance of the models on this context is conditioned on indicators that exceed 5% confidence level, 75% by approximation, 10% variation and 0.8 for reliability [16].

3 Results

The sound intensity and high vehicle traffic in the second stage, was processed on critical periods of two hours, that are represented on the Figs. 2 and 3.

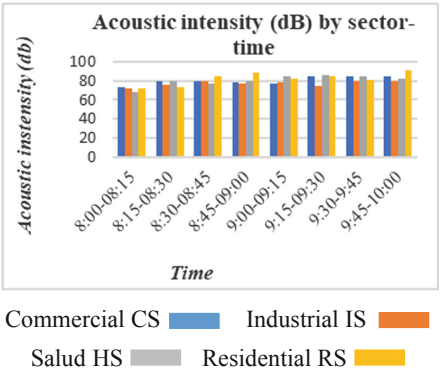

Fig. 2. Sound critical intensity per sector

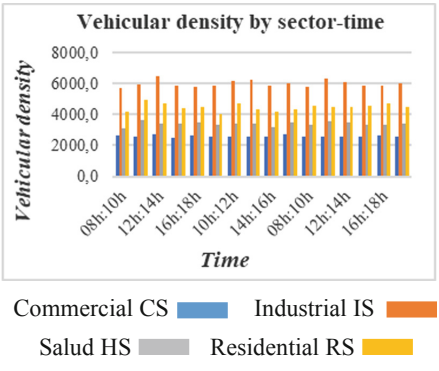

Fig. 3. Critical vehicle density per sector

The evaluated models evidenced that the distortion between both stages is less than 11% and 1% respectively for the noise and vehicle traffic. These are described in Fig. 4 and 5. Further, the models proved the noise level for vehicle traffic in percentage, which vary between 78% for Health Sector and 10% to Industrial Sector.

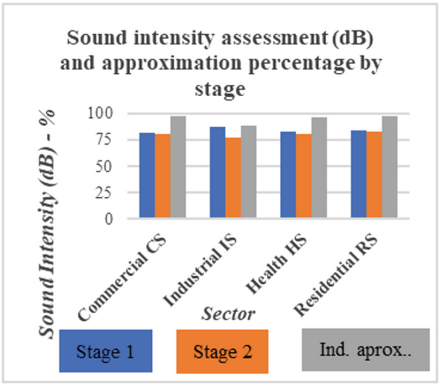

Fig. 4. Sound critical intensity per sector

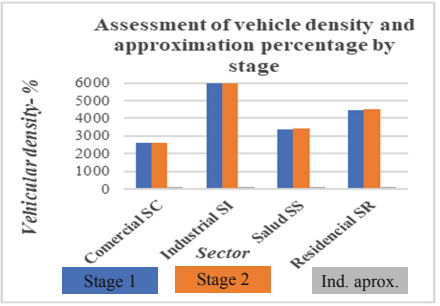

Fig. 5. Vehicular critical density per sector

The citizen perception for the second phase was analyzed for surveys and interviews, which ratifies the noise problem for both stages. The calculated indicators exceed 95%, as the Fig. 6 describes. The Fig. 7 shows the relationship between sound intensity and vehicular traffic for stage 2, which validates the correlation for both researched phases.

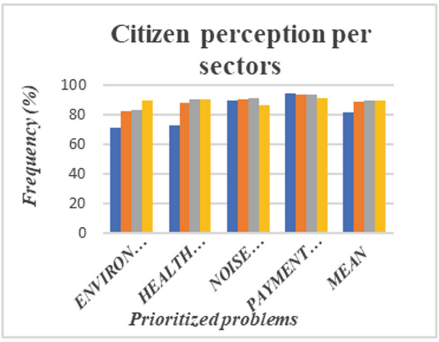

Fig. 6. Stage 2. Citizen perception per sector

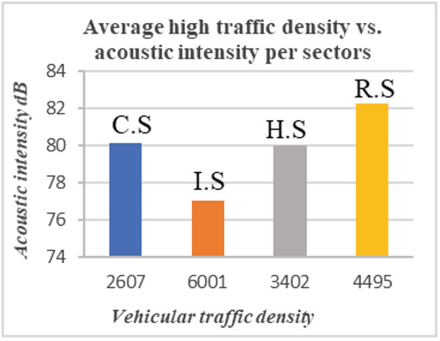

Fig. 7. Stage 2. Sound critical intensity per vehicular traffic and sector

By means of the relationship between the noise intensity and vehicle traffic distortion indicators for both stages, the general distortion indicator is less than 7%, which validate and calibrate the results for both geo territories and it's described in Fig. 8.

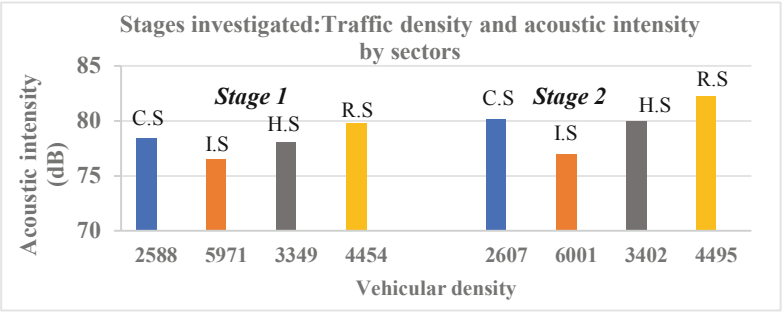

Fig. 8. Variation between the stages and per sectors

In order to calibrate and validate the results of both stages, acceptability levels were calculated, as detailed in Table 2. The estimated indicators >5%, >75%, <10% y > 0,8, quantify the validity of the results for both phases. The indicators confirm the applicability of models to the city and the noise behavior due to high traffic for Guayaquil.

Table 2. Evaluation of the 2 stages by most critical indicators through variables involved

Model	Variables analyzed			Acceptability level standard	Acceptability
	Sound intensity (%)	Vehicular high density (%)	Citizen perception (%)		
Comparison of means	18	5,3	7	>5% (probability)	Acceptable
Approximation by means	84	98	99	>75%	Acceptable
Approximation by standard deviation	78	86	83	>75%	Acceptable
Variation coefficient	8	5	2	<10%	Acceptable
Alfa de Cronbach	8,2–6,9	218–226	9,6–11,5	• 0,8	High confidence

4 Discussion

The results for both researched stages determine indicators that is from high to very high, which validates the analysis of geo territorial prototypes in order to calculate the generated noise by vehicular traffic for Guayaquil.

The results determine a generalized acoustic problem for the city, with noise intensities that vary between 10% and 78%. The Health Sector is the most affected and the industrial sector the least affected.

The methodological development and the calculated products generate a quantitative and perceptive process, applicable to determine acoustic conflicts and validate the extrapolation of effects in territorial spaces bigger than those selected as prototypes.

5 Conclusion

The application of the models estimated in stage 1 of the investigation was calibrated and validated.

Stage 2 determined the generalization of application models in Guayaquil, that were calculated with the initial prototype's sites.

The high noise-vehicular traffic conflict for the 2 stages was validated with high levels of confidence with statistical and probabilistic methods.

The methodology for calculating sound conflicts with wide and varied territorial spaces is relevant to the implemented and developed process.

The investigations in both stages determine the acoustic problem in Guayaquil and generate indicators for sound territorial planning.

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Green Areas Plan with Native and/or Endemic Plants for Mitigation of Heat Island in Letamendi Parish, Guayaquil

Jackeline Salinas(✉), Gabriela Vega, and Jesús Rafael Hechavarría Hernández

Faculty of Architecture and Urbanism, University of Guayaquil, Cdla. Salvador Allende, Av. Delta y Av. Kennedy, Guayaquil, Ecuador
{jackeline.salinasja, gabriela.vegag, jesus.hechavarriah}@ug.edu.ec

Abstract. Together with the urban development of the city of Guayaquil, the ecosystems present in the urban zone were mostly lost; the need for spaces with vegetation that mitigate the different environmental consequences of the growth of the city is evident. However, the use of imported vegetation and inadequate to the type of climate is a practice in the design of the urban landscape that has extended over the years. Among the effects of these decisions, we can highlight the loss of identity of the vegetation and the increase in costs for investment, maintenance and adaptability. This study aims to recommend the use of native and/or endemic species suitable for use in the design of green areas, proposing the use of vegetation typical of the city to be implemented in the urban landscape. The use of a system with this type of vegetation provides the city with the identification and quantification of its flora, and encourages the conservation of species in public spaces. Also serves the purpose of reducing the urban heat island effect characteristic of extremely populated cities, as is the case of Guayaquil.

Keywords: Landscape design · Endemic · Green areas · Heat island · Urban regeneration · Environment

1 Introduction

Urban development produces the concentration of the population in a given territory, whose natural environment. Because of this growth is altered and affects the deterioration of the environment, disappearing the plant surface present in each ecosystem. Likewise, without proper planning, more environmental problems occur and generate that produces negative effects on the environment and quality of life in general [1].

The growth of cities intervenes in the natural landscape by altering ecosystems housed in a given territory, disrupting the diversity of flora and fauna present in that territory. Ecological balance is affected by urban development by decreasing green areas that are affected by affectation to population or disappearing certain vegetable species. This is a fact that can be perceived more clearly in developing cities which retain traces of intervened ecosystems [2].

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The process of modifying the land cover produced by the growth of cities waterproofs its surface and is one of the main causes of the appearance of heat islands (ICU) that represents environmental problems for the inhabitants of a city as it constitutes the temperature difference between the urban area and its surroundings or rural areas where the soil is permeable [3].

The sowing and conservation of own species within parks and public spaces brings environmental, social and economic benefits to the community, because no plant species are imported and social consequences are saved, the use of leafy vegetation helps to improve the microclimate of its environment and helps prolong the life of dependent species. The spaces with the presence of vegetation, especially tree species, help mitigate urban noise that affects people's quality of life [4].

Urban landscaping in which the use of the native flora of a territory is considered, provides identity and/or belonging to its inhabitants and helps the conservation of dependent fauna contributing to the intervened environment [5].

The objective is to propose the implementation of a landscape design by inserting native and/or endemic flora for the green areas of the Letamendi parish, in order to mitigate the heat island, present in the area, for this the existing vegetation will be inventoried in green areas of the study sector.

In order to know the urban process of the sector, a historical comparative analysis of the forest ecosystem of the study sector will be prepared, through the bibliographic review and the application of surveys as a research method.

Finally, a technical guide of native and/or endemic flora for green areas of the parish will be produced, in which the landscape proposal will be designed in green areas where the absence of tree cover is evidenced through the insertion of native flora and/or endemic.

2 Materials and Methods

2.1 Delimitation of the Study Area

Guayaquil, is located between 2°3′ and 2°17′ south latitude; and the 79°59′ and 79°49′ west longitude, consisting of 16 urban parishes and 5 rural parishes. The parish Letamendi, object of the present study is located in the urban area of the city of Guayaquil with an approximate area of 3.40 km^2 and a population of 95,943 inhabitants, is within a high degree of urban density according to studies and who inhabit in it they have more unfavorable economic conditions, in addition to being subject to high or moderate flood risks due to the degree of waterproofing it has [6].

It is located south west of the city, natively the natural landscape of this parish was constituted by estuaries whose predominant species are mangroves, their presence has disappeared. Within this parish are parks, flower beds and the lags of an agonizing estuary, together they have an approximate area of 28,279 m^2, translated approximately 0.30 m^2 per inhabitant of this parish, a green urban index considered low. By the (Source: WHO) It can be mentioned that the city of Monterrey adopted a demographic-ecological process including the implementation of trees which are of help to improve

the climate and the environment where they are in addition to providing habitability of the birds, due This also serves as a hierarchy of urban landscape spaces [7].

2.2 Methodology

With the purpose of obtaining a recommended guide of native and/or endemic plant species in the study sector the qualitative descriptive method will be used so that the recommendation of each species is determined through physiological and ornamental attributes. In order to achieve the appropriation of the inhabitants of a territory native and/or endemic species must be considered to have certain advantages because they are accustomed to the different climatic and physical factors of a given place. The conception of a typical typology of tree elements will allow achieving the landscape identification of the city.

Sizing of public space, the sizing of each public space existing in the parish it is described in the Table 1, with the purpose of knowing the degree of permanence of the population in each place. The observation was used to determine the influx of people to these places, their frequency of transit and periods of permanence on the part of the inhabitants.

Table 1. Frequency of people in public spaces of the study sector.

Publics Spaces in Parish Letamendi	Area (km/m^2)	Daily pedestrian frequency (9H00–12H00)	Permanence (Minutes)	Introduced Species (%)
Av. Federico Godín	618,79	30	2	100
Street 17 ava	123,50	45	2	100
Park Domingo Savio	2785,00	15	15	100
Park Bellavista	775,87	30	20	100
Park Virgen del Soto	755,08	15	15	100
Park Puerto Lisa	2492,00	80	60	95
Linear park Las Ranas	1,7 (km)	25 (Sect. 2)	10	100

Source: Own elaboration.

Historical Comparative Graphic Analysis. In the images 2 and 3 where the development of the parish is observed that at the beginning of urbanization had mangrove areas and extensions of dry forest typical of the city's ecosystem, in contrast to its current situation where the waterproofing of Its soil is total, so the presence of heat islands is remarkable and a stretch of estuary still surviving this population development remains with little mangrove coverage (Fig. 1).

Selection of Applicable Species. In the Table 2 shows a general proposal of ornamental species, which belong to the ecosystem of the study sector, and can be used as a platform in the proposal of typology of representative species within the green area spaces of the parish.

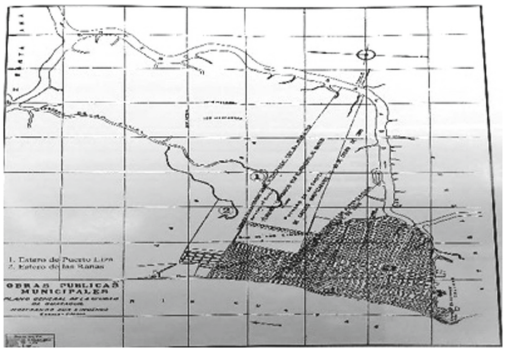

Fig. 1. Map of Letamendi parish, estuaries. Source: Historical Guide of Guayaquil [8]

Table 2. General proposal of species to propose.

Use of species	Scientific name	Traditional name
Upholstery plants	Melissa officinalis	Melissa
	Chamaemelum nobile	Chamomile
	Origanum vulgare	Oregano
Low Vegetation	Thalia pavonii	Not registered
	Nymphaea oxypetala	Wonder of Guayaquil
	Epidendrum bracteolatum	Suelda with sueda
	Encyclia angustiloba	Christmas flower
	Ocimum basilicum	Basil
	Conocarpus erectus	Mangle Jelí
Shrubbery	Gustavia angustifolia	Mountain Quince
	Conocarpus erectus	Mangle Jelí
	Croton churutensis	Croton
Trees	Ochroma pyramidale	Raft, buoy

Source: Own elaboration.

Choice of Landscape Profile. With the proposed species, we seek to obtain a landscape profile that integrates harmoniously with the urban environment and the characteristics of the area, by creating scenarios that take into account aesthetic variables, integration of light and shadow games, aromas, and other characteristics. of flora species. A guide of species to be proposed in each of the existing public spaces was determined from the collection of data on the flora that adapts to the climate of the city because it is native and has the characteristics described above.

Table 3. Proposal of ornamental species by type of public space/green area.

Spaces publics	Ornamentals species	Scientific name	Traditional name
Flower beds	Upholstery plants	Origanum vulgare	Oregano
		Melissa officinalis	Melissa
	Low Vegetation	Encyclia angustiloba	Christmas flower
		Ocimum basilicum	Basil
	Trees	Pseudosamanea guachapele	Guachapelí
		Cordia macrantha	Laurel de Puná
		Ochroma pyramidale	Raft
Park	Upholstery plants	Origanum vulgare	Oregano
		Melissa officinalis	Melissa
		Chamaemelum nobile	Chamomile
	Low Vegetation	Vasconcellea parviflora	Bromeliad
		Encyclia angustiloba	Christmas flower
		Ocimum basilicum	Basil
	Trees	Conocarpus erectus	Mangle Jelí
		Simira ecuadorensis	Colorado
		Pseudosamanea guachapele	Guachapelí
		Cordia macrantha	Laurel de Puná
Lineal Park	Upholstery plants	Origanum vulgare	Oregano
		Melissa officinalis	Melissa
		Chamaemelum nobile	Chamomile
	Low Vegetation	Nymphaea oxypetala	Wonder of Guayaquil
		Thalia pavonii	Not registered
	Trees	Avicennia germinans	Black mangrove
		Laguncularia racemosa	White mangrove
		Conocarpus erectus	Mangle Jelí
		Erythrina velutina Wild	Pepito colorado
Avenium/sidewalks	Upholstery plants	Origanum vulgare	Oregano
	Low Vegetation	Ocimum basilicum	Basil
		Epidendrum bracteolatum	Suelda con suelda

Source: Own elaboration.

3 Results

The use of natural and/or endemic species, whose properties have ornamental and relief characteristics to the heat islands present in the place of study, contribute to the environmental balance and remedy the intervened ecosystem, there is no carbon footprint impact as it is not transported or is introduced from other places on the planet, and contribute to maintaining the diversity of flora and fauna belonging to a given

territory. An adult and healthy tree can produce oxygen for 10 people a year and absorbs 21 kilograms of CO_2 compared to palms, which have the same benefits, but 70% less. The proposed species were those shown in the Table 3, because they belong to the ecosystem of the study area. The use of own species helps to maintain the fragile balance of an ecosystem and treasure biodiversity, in addition to the knowledge of native or endemic flora contributes to the attachment of the population to its environment. The adoption of own species that are also preferably trees means a greater contribution of oxygen to a city that has a high rate of automotive fleet and lacks the adequate number of green areas per inhabitant. The proposed species that were planted required previous work in their roots when considering the underground infrastructure built as well as the aerial wiring.

The parish Letamendi has a low urban green index, so it was not only in the flower beds and parks that the use of native species that have ornamental characteristics and are capable of providing shade was considered. Also on the sidewalks whose width favors the implementation of forests in pots to counteract heat waves in hours of greater solar intensity due to the geographical position of Ecuador (Fig. 2).

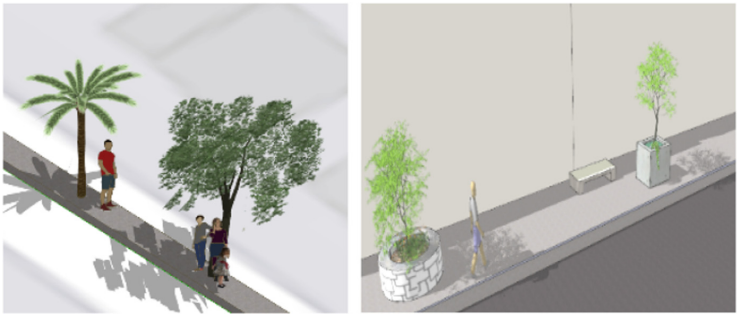

Fig. 2. Difference of shadow cast between a permanent leaf tree and a palm and arborization proposal on sidewalks with native species. Source: Own elaboration.

4 Discussion

A plan of endemic or native species has been proposed and implemented successfully in other countries where it has been sought to rescue and preserve the biodiversity of each territory, managing it as an articulated system according to the species and the adaptability of each other and therefore of its means of existence. During the course of the present work, the perception of the residents next to the different spaces that contain green areas within the parish who have no appropriation of certain places due to the evident insecurity situation of the different sectors was interpreted, therefore, in the different interviews were reluctant to express their discomfort, however, the possibility of proposals for an urban tree plan seemed to identify the different recreational needs needed to lead a balanced life from the urban point of view and the human requirements of An individual.

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Environmental Certification Proposal for Sustainable Buildings in the Satellite Parish "La Aurora", Guayas, Ecuador

Christian Zambrano Murillo[1(✉)], Jesús Rafael Hechavarría Hernández[1(✉)], and Maikel Leyva Vázquez[2(✉)]

[1] School of Architecture and Urbanism, University of Guayaquil, Guayaquil, Ecuador
{christian.zambranomu, jesus.hechavarriah}@ug.edu.ec
[2] Faculty of Commercial Education and Sciences, Bolivariano Technological Institute of Technology, Guayaquil, Ecuador
mleyva@itb.edu.ec

Abstract. Urban sprawl increased in a disorderly and unplanned manner in Guayaquil, creating urbanizations on rural lands in neighboring cantons, reducing agricultural use spaces. The satellite parish "La Aurora" located in Daule has become one of the "Dormitory" cities of greater Guayaquil, with 57 private urbanizations. The proposal for an environmental certification design of sustainable buildings made through the study of existing certifications and the analysis of diffuse decision maps with neutral TOPSIS methods. The indicators for mitigating environmental pollution include the use of materials with low CO2 content and clean energy. The results show that the tool allows prioritizing the construction processes and selecting the best alternative in ecological indicators with respect to environmental impact. The certification will be a guide for designers, promoters and builders, who want to incorporate an ecological plus to their projects.

Keywords: Human factors in architecture · Sustainable urban planning and infrastructure · Sustainable development

1 Introduction

CO2 capture has decreased due to the loss of green areas, caused by unplanned and disorderly urban expansion in Guayaquil, a city that has slowed down its extension due to its natural limits, which prevent its development [1] and has led to the creation of housing estates in rural areas in the cantons of Daule, Samborondón and Durán. The satellite parish "La Aurora" of Daule has become one of the "dormitory" cities of the great Guayaquil. The construction industry consumes large amounts of energy and material throughout its life cycle, as well as machinery that uses fossil fuel. Guayaquil is the second largest contributor of pollutant emissions in the country [2]. The lack of regulations on environmental management and reforestation generates environmental liabilities that drastically pollute the natural environment of the parish of La Aurora.

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2 Sustainable Development

Environmental management is the process of reversing past degradation, resolving current conflicts and preventing future problems in order to achieve sustainable development [3]. The first Earth Summit, held in Stockholm in 1972, marked a turning point in environmental policy [4]. In 1987, the United Nations published the Brundtland Report entitled Our Common Future, which stated, Sustainable development is development that meets the needs of this generation without compromising the capacity of future generations to satisfy their own needs. Sustainable development, which was mentioned again at the Earth Summit in Rio de Janeiro in 1992, with 27 principles linking two apparently contradictory realities, development and respect for the environment. It concludes that economic growth does not automatically improve people's lives; industrialized and developing countries have an opportunity to design a new international convention and ensure sustainable human development [5]. Sustainability must balanced in three dimensions, economic, social and environmental, which must endure over time; usually the issue of environmental sustainability not realized in the real estate industry [6].

2.1 Environmental Certifications

The environmental certification is an accreditation granted by an evaluating agency, which verifies that the products, processes or services performed with environmental awareness, aligned with the environmental regulations in force, which has as an integrating axis the management of environmental aspects to minimize risks and adverse impacts on the environment. In Ecuador, the Ministry of the Environment (MAE) grants two environmental certifications, the Punto Verde certification and the Carbono Neutro certification, encouraging public and private sector companies to use new clean and sustainable practices, favoring the company's image by providing added value in relation to its competitors [7].

2.2 Sustainable Building Assessment Tools

LEED (Leadership in Energy & Environmental Design), is a building certification system based on market criteria to develop and implement sustainable practices of high efficiency in the life cycle of a building. BREEAM (Building Research Establishment Environmental Assessment Method) is the sustainability analysis and certification system, which uses tools and procedures aimed at measuring, evaluating and weighing the sustainability levels of the building in its design, execution and maintenance phases. EDGE (Excellence in Design for Greater Efficiencies) is a certification system for green building, which aims to help developers and builders establish cost-effective ways to reduce energy, water, and materials from the design process through construction. Punto Verde Certification is the "Ecuadorian environmental certification to sustainable construction" seeks to make buildings safe, functional and sustainable (Fig. 1). It is aimed at new construction or renovation projects, applicable to projects that have environmental permits in accordance with the catalogue of projects, works or activities established by the National Environmental Authority (AAN) [8].

Fig. 1. LEED, BREEAM, EDGE and Punto Verde certifications

These certifications contain similar examination factors (Fig. 2), and base much of their study on analyzing them. The study and implementation of a holistic methodology as tools for the sustainable evaluation of housing construction, focused on minimizing the amount of resources currently consumed by buildings during their life cycle, which allows evidence of the shortcomings in the use of energy, water, materials and the correct design in all its stages with their respective compliance with current regulations.

	ENERGY	WATER	MATERIALS	SITES	INNOVATION	INDOOR QUALITY	MANAGEMENT
LEED							
BREEAM							
EDGE							
PUNTO VERDE							

Fig. 2. LEED, BREEAM, EDGE and Punto Verde certifications factor comparison

3 Materials and Methods

3.1 Population Study

Daule has 57 private urbanizations among which are La Rioja, Villa Italia, La Joya, Villa Club and Villas del Rey, these being the most densely populated in the satellite parish of La Aurora; between Villa Club, La Joya and Villas del Rey there are 17557 homes. Considering the inclusion and exclusion criteria for the population delimitation, the sample size is 376 homes, with a 5% margin of error. The surveys carried out via the Internet, by means of Question Pro, sent to residents of the urbanizations. To calculate the number of dwellings, Google Earth software used, which via satellite allowed for counting the dwellings by stage. Once the sample was calculated, it began with the massive sending of the survey to the residents of said housing estates, and

through the SPSS software, the processing of the data acquired in the survey carried out, providing the results shown in Fig. 3.

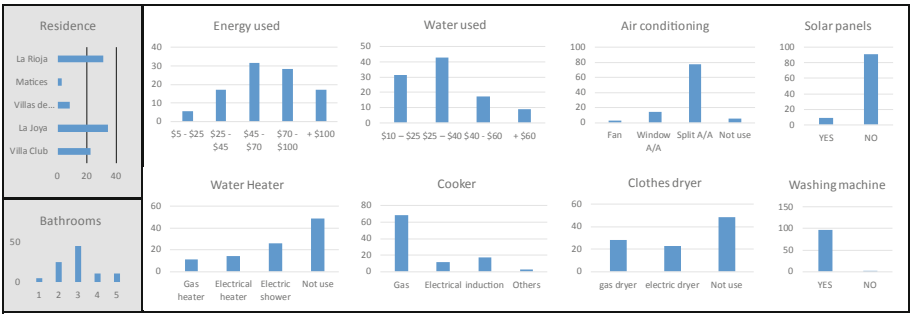

Fig. 3. Results of the survey to residents of urbanizations in "La Aurora"

The province of Guayas has the highest annual per capita consumption, estimating the number of people per house at 3.5, a monthly consumption per house of 487.81 kWh/inhabitant, and according to the CNEL tariff table, 450 kWh/inhabitant; it is worth mentioning that the use of alternative energies is almost zero. Likewise, water consumption is 21 m3 per month according to the data surveyed (Fig. 3).

3.2 Comparative Analysis of LEED, BREEAM, EDGE and Punto Verde Certifications

For the certification proposal, the methodologies for environmental certification in the construction sector used in the country chosen, although it is not a very common practice in buildings. Punto Verde, as the only national certification that granted in the country, LEED and BREEAM as international alternatives, additional is EDGE that promoted by the Municipality of Guayaquil. The detailed study of the above mentioned certifications was carried out and their action was weighted in the factors reviewed in their respective certifications (Fig. 4), denoting the importance given to each segment studied in order to create the methodology for environmental assessment in local buildings that help mitigate the environmental impacts that trigger climate change.

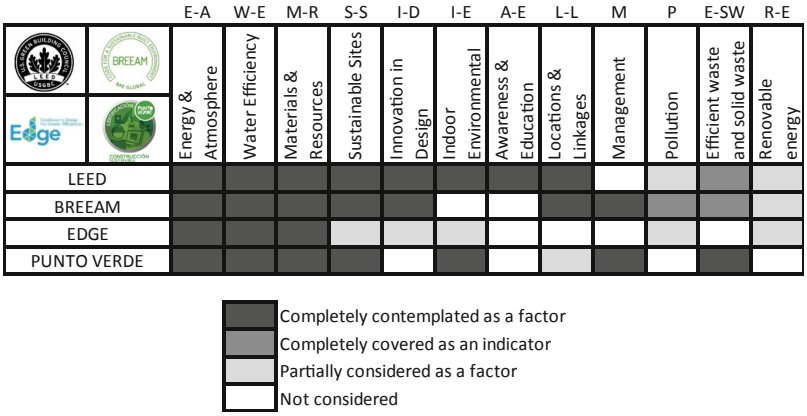

Fig. 4. Weighting of factors evaluated in the LEDD, BREEAM, EDGE and Punto Verde certifications.

3.3 Multi-criteria Analysis Methodology for Definition Taking AHP y TOPSIS

AHP (Analytical Hierarchy Process) is a process developed by Thomas L. Saaty (1977), which requires providing subjective assessments regarding the relative importance of each of the criteria through a preference scale (Fig. 5). Then specifying priorities among the criteria and alternatives, simplifying the preference ratings among the decision criteria using pairwise comparisons resulting in a prioritization, synthesizing the judgments, evaluating and checking the consistency of the judgments showing the overall preference for each of the decision alternatives [9].

Scale	Degree of preference
1	Equal importance
3	Moderate importance of one factor over another
5	Strong or essential importance
7	Very strong importance
9	Extreme importance
2,4,6,8	Values for inverse comparison

Fig. 5. AHP preference scale

One tool used to understand complex systems through a casual model, to achieve one or more objectives is the fuzzy decision map (FDM) [10]. It allows the use of linguistically neutral values, to represent the relative importance among the criteria of the preference matrix, as well as the representation of the relative influence among the criteria for the calculation of the steady state matrix. The proposed model is called Linguistically Neutral Fuzzy Decision Networks (LFDN) and is used together with the multi-criteria method TOPSIS (Preferential Arrangement Technique by Similarity to Ideal Solution), relative versus absolute. It is based on the resolution of the problems

posed by means of hierarchization by means of algorithms [11], a method for ordering a finite number of alternatives. The selected alternative will have the largest distance to the ideal negative distance and the smallest distance to the ideal positive solution developed in stages (Fig. 6).

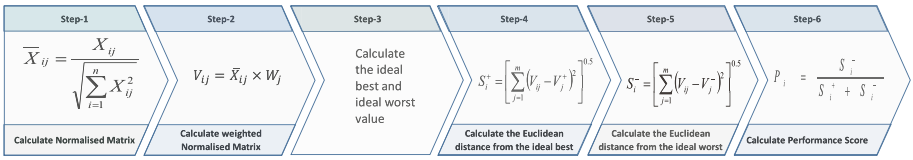

Fig. 6. Stages of the TOPSIS procedure

3.4 Analysis of Environmental Assessment Factors Based on LEED, BREAM, EDGE and Punto Verde

In order to give them relative weight within the building assessment, the importance of the indicators was weighted, through AHP, in such a way as to be objective in terms of the extent, intensity and potential duration of the effects, depending on the resource efficiency, sustainability indicators and pollution mitigation carried out in the process (Fig. 7). The TOPSIS analysis was then performed considering the most common factors of the above mentioned certifications (Fig. 2), presenting the highest score in the evaluation of sustainable processes in buildings (Fig. 8).

	Efficiency	Enviromental	Economy	Social	Mitigation
Efficiency	**1,00**	0,14	3,00	3,00	0,20
Enviromental	7,00	**1,00**	3,00	5,00	0,33
Economy	0,33	0,33	**1,00**	3,00	0,14
Social	0,33	0,20	0,33	**1,00**	0,20
Mitigation	5,00	3,00	7,00	5,00	**1,00**
sum	13,667	4,676	14,333	17,000	1,876

	Efficiency	Enviromental	Economy	Social	Mitigation	Weights
Efficiency	0,073	0,031	0,209	0,176	0,107	0,1192
Enviromental	0,512	0,214	0,209	0,294	0,178	0,2814
Economy	0,024	0,071	0,070	0,176	0,076	0,0836
Social	0,024	0,043	0,023	0,059	0,107	0,0512
Mitigation	0,366	0,642	0,488	0,294	0,533	0,4646
checksum	1,000	1,000	1,000	1,000	1,000	1,0000

Fig. 7. Weighting according to AHP

weightage	Efficiency (EFF)	Enviromental (ENV)	Economy (ECO)	Social (SOC)	Mitigation (MIT)
	0,1192	0,2814	0,0836	0,0512	0,4646

STEP 1	EFF	ENV	ECO	SOC	MIT
Energy & Atmosphere	7	8	7	6	8
Water Efficiency	7	8	7	6	8
Materials & Resources	5	8	3	3	7
Sustainable Sites	3	7	5	3	7
Innovation in Design	7	7	4	5	7
Indoor Environmental Quality	5	4	5	8	5
Awareness & Education	5	7	3	7	7
Locations & Linkages	7	6	6	5	7

STEP 2	EFF	ENV	ECO	SOC	MIT
Energy & Atmosphere	0,4183	0,4046	0,4741	0,3772	0,4010
Water Efficiency	0,4183	0,4046	0,4741	0,3772	0,4010
Materials & Resources	0,2988	0,4046	0,2032	0,1886	0,3509
Sustainable Sites	0,1793	0,3540	0,3386	0,1886	0,3509
Innovation in Design	0,4183	0,3540	0,2709	0,3143	0,3509
Indoor Environmental Quality	0,2988	0,2023	0,3386	0,5030	0,2506
Awareness & Education	0,2988	0,3540	0,2032	0,4401	0,3509
Locations & Linkages	0,4183	0,3034	0,4064	0,3143	0,3509

STEP 3	EFF	ENV	ECO	SOC	MIT
Ideal Best - V+	0,0214	0,0569	0,0170	0,0097	0,1164
Ideal Worst - V-	0,0499	0,1139	0,0396	0,0257	0,1863

RESULTS	Si+	Si-	Pi	Rank
Energy & Atmosphere	0,09767	0,00643	0,06180	1
Water Efficiency	0,09767	0,00643	0,06180	1
Materials & Resources	0,07492	0,03895	0,34206	4
Sustainable Sites	0,06419	0,04409	0,40719	7
Innovation in Design	0,06984	0,03356	0,32459	3
Indoor Environmental Quality	0,02429	0,09194	0,79101	8
Awareness & Education	0,06604	0,03836	0,36743	5
Locations & Linkages	0,06420	0,03844	0,37452	6

Fig. 8. TOPSIS methodology result.

4 HES Certification (Hacia Edificaciones Sostenibles)

The objective is to mitigate environmental impacts in construction, promote economic investment in sustainable practices, provide the real estate sector with a sustainable assessment method and induce the use of clean energy. The proposal consists of eight factors, evaluated in their application according to the range shown in Fig. 9, based on the awarding of points, which calculated using the environmental weighting of the TOPSIS classification. The results of each factor added up to obtain the overall score that indicates the degree to which the project contributes to mitigation.

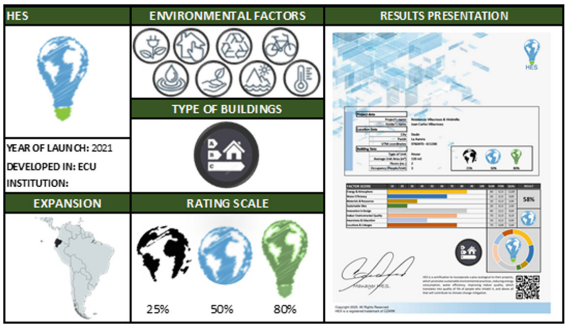

Fig. 9. Proposal for HES sustainable certification

5 Conclusion

The construction sector accounts for nearly 40% of total energy-related dioxide emissions and 36% of energy end-use worldwide. Population growth means that energy demand in buildings may increase by 50% by 2060. Global buildings projected to double by 2050, increasing energy demand and building-related GHG emissions.

Construction offers the best potential for cost-effective GHG mitigation through the application of existing technologies, policies and building styles.

The assessment methods developed in first world countries tend to focus on environmental aspects, however they do not usually address social and economic aspects. The evaluation must be carried out according to the reality of the territory, construction system and energy culture. These can be adapted, but an evaluation should made according to local parameters and criteria. The certification will be a guide for those who wish to incorporate an ecological plus to their projects; this will demand an increase in production costs, which will recovered by the reduction of energy and water consumption; better health and quality of life, contributing to the mitigation of climate change by reducing the carbon footprint to zero.

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Explore Urban Sustainable Ecology Construction from Bio-design Perspective

Fan Wu and Jun Zhang(✉)

School of Design, Hunan University, No. 2 South Lushan Road, Changsha 410082, Hunan, China
zhangjun@hnu.edu.cn

Abstract. Industrialization and economic expansion emerged in developing countries accelerate the process of urbanization, while some ecological problems such as natural ecology system damage and transformation of urban land also showed up. In the prophase of urban ecology planning, sustainable development should be taken into consideration to reduce the further transformation of the city and ecological restoration in the later period. For the purpose, this paper applied a framework of sustainable urban ecological construction to the problems that urban areas are facing with. A Bio-related design based perspective is proposed: focusing on the relationship among biological principles, organisms and design. Given three different sustainability research aspects: urban resilience, urban environment and urban biodiversity, this paper provides some suggestions for urban ecology construction. Key research questions for urban planners, landscape ecologists and designers are posed to advance the development of urban ecology in a bio-design mode.

Keywords: Bio-design · Urban ecosystem · Symbiotic · Biomimetics · Sustainability

1 Introduction

Urbanization is a necessary path for the development of many regions around the world. It has continuously improved the quality of life of urban residents and greatly facilitated people's daily lives. However, with the advancement of urbanization, many environmental problems have also arisen. The damage to environment is of critical concern. Many factors are contributing to urban ecological transformation including cities under construction, expanding urbanization to rural areas, and wasteland of city [1]. The sustainable development of a city is closely related to the urban ecology. In order to achieve urban ecological sustainability, it is necessary to have a deep understanding of the city's local ecology and the external natural ecology.

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2 Bio-design

2.1 The Relationship Between Design and Biology

Many iterations and fusions have emerged through the evolvement of the concept: Bio-inspired Design. The problem we need to focus on is not just the change and replacement of concepts, but the analysis of the relationship between design and biology [2]. For example, Biomimicry means we imitate some special characteristics of organisms [3]. In this case, imitation is the relationship between design and organisms. We should put our attention to the depth and form of the combination of biology and design, and then figure out the role of organisms: material, content or just the inspiration of design.

2.2 From Concept to Relationship

The concept of Bio-design is sometimes blurred, and some of them may be just a variant and continuation of previous concepts. The development of bio-related design concept is given in Table 1. These concepts in the table are still in use today, and correspond to this continuation process. For the division of biological design, with the continuous expansion and improvement of concepts. Our way of thinking requires some changes. From conceptual thinking to a way of thinking about relationships.

Table 1. Glossary of bio-related design terms and concepts

Concept	Definition	References
Biomimetic	A science concerned with the application of data about the functioning of biological systems to the solution of engineering problems	Schmitt O. Third Int. Biophysics Congress. 1969. Some interesting and useful biomimetic transforms. p. 297. [4]
Biomimicry	A "new science that studies nature's models and then imitates or takes inspiration from these designs and processes to solve human problems"	Merrill, Connie Lange (1982). "Biomimicry of the Dioxygen Active Site in the Copper Proteins Hemocyanin and Cytochrome Oxidase". Rice University. [5]
Bionics	"The science of systems which have some function copied from nature, or which represent characteristics of natural systems or their analogues"	Mary McCarty. "Life of bionics founder a fine adventure". Dayton Daily News, 29 January 2009. [6]

Based on the above concept, we have simply classified some common bio-related design concepts (Fig. 1). These concepts are divided into several relationships such as imitation, integration, utilization, transplantation, and regeneration. For each type of relationship, some similar or related concepts can be classified into one category. If the concepts related to biological design are considered using the relationship between biology and design, many concepts will become clearer. It also can be used to urban planning.

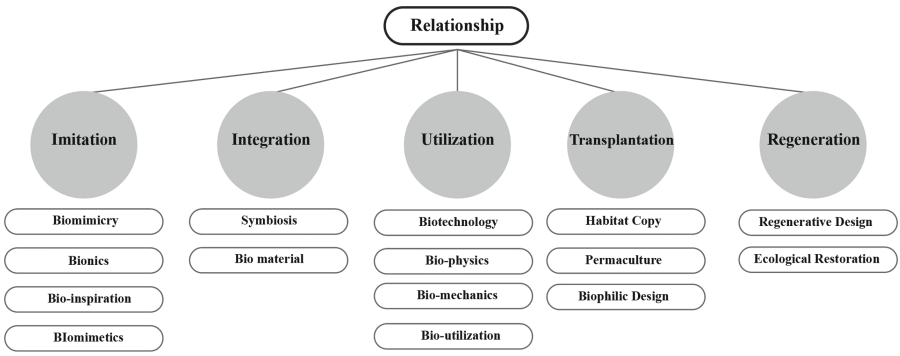

Fig. 1. The Bio-design zone

3 Discussion on the Path of Urban Bio-design

3.1 Urban Resilience

Urban resilience is also called "Flexible City". The concept of "Flexible City" was created to effectively invoke the resources that cities can use to maintain key functions [7]. This is a precautionary concept to enable cities to cope with unexpected situations that exceed their daily operating conditions. As climate change continues to intensify and the frequency of various ecological crises increases, a city's ability to resist disasters becomes particularly significant. Of course, the resilience of a region is not only about its ability to cope with natural disasters, such as emergency design for some areas prone to natural disasters. Urban resilience should also consider the complex, long-term, and sustainable development of an area to face with challenges from social, economic, and environmental aspects.

Jack Ahern proposed five strategies to enhance urban resilience and interdisciplinary cooperation: biodiversity, urban ecological networks and links, planning and designing cities for versatility, modularity, adaptive design [8]. The improvement of urban resilience includes both the system level and some specific designs for a certain area. It is necessary to consider both the urban infrastructure and various creatures living in the city [9]. Under the concept of "Flexible City", the functions of city can be expanded. The biological design for urban resilience is mainly at the level of "utilization" (Fig. 2), that is, the realization of functions is based on the direct use of organisms. In normal times, these creatures may play a decorative role. Once there are some problems in the urban environment or the city encounters some disasters, these creatures will assume certain functions.

3.2 Biological Design for Different Urban Environments

Imitate Habitat of Organisms. Urban environment are often compared with rural or wilderness areas and are typically characterized by less plant, highly polluted. Many people generally believe that plant types in urban areas are dominated by species such as weeds, because these species can better adapt to human-induced changes to the environment. In some hardened areas of the city. In fact, because of the special geological structure in urban areas, some of the dominant plants in cities are species that often live in some rocky areas, while grassland and floodplains are rare. To a certain extent, the urban built environment can reproduce the habitat templates required by plants in these rocky areas [10]. This kind of copy may sometimes be unintentional, but as a method of restoring and transforming the urban ecology, we can transform it into a deliberate way. That is, in some areas of the city, before introducing plants in nature, analyze the natural habitat of the plants first, and then imitate this habitat in the urban environment (Fig. 4). In addition to creating novel ecological habitats, urban ecological theory can also construct corresponding forms to replicate some habitat analogs.

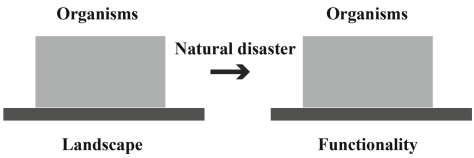

Fig. 2. Utilization

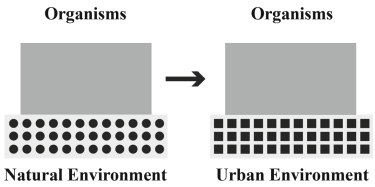

Fig. 3. Imitation. Imitate the natural environment of organisms

Fig. 4. Sanya Mangrove Ecological Park. Brown lands (*left*). After ecological restoration (*right*) [13]

Ecological Restoration Using Natural Ecology as a Template. Except for the land occupied by urban buildings and residential areas, there are many other types of land in cities, such as brown land, greenways, urban farms, urban parks, and so on. Among them, Brownfield Sit is a special land type, which mainly refers to the wasteland that was once used for development and construction [11]. The problem of ecological restoration of brown lands is more about the restoration of the ecology of this area. Because of human activities, brown lands have greatly affected the natural ecology of this area. If these old facilities and buildings cannot be reused in the later period, the ecology of the infrastructure that was used to build these infrastructures will not be restored and some of the pollution caused by brown land to its area will not be timely clean up and repair.

For large-scale ecological reconstruction, it is necessary to extract templates from nature. Sanya Mangrove Ecological Park is a typical case for this type (Fig. 4). The park is designed to restore the wetland system with the concept of mangrove root system and establish a habitat suitable for mangrove growth. Mangrove planting is combined with natural succession to restore mangroves in a healthy and stable way [12]. The mangrove ecological park imitated the native mangrove community, and the mangrove plantation is combined with natural succession to restore the mangrove forest and enrich the vegetation community.

3.3 Maintenance of Urban Biodiversity

The urban area is a highly transformed place with some complex landscape conditions. At the same time, cities are hotspots with abundant plant species, and sometimes even richer in species types than the rural areas around the cities. Thus, the protection and restoration of urban biodiversity is a very important task for city planners. Animals living in cities are often affected by human activities. Green space and open land are as equal important for humans as wild animals living in cities. The decrease of green land in city become a huge threaten for creatures in city.

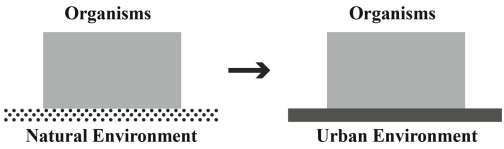

Fig. 5. Transplantation

On the issue of urban biodiversity, it does not mean that the introduction of some species that cities do not have will allow cities to restore a natural ecology. On the one hand, the introduced species may conflict with the urban indigenous species, which will have a more serious impact on the city's local ecology. On the other hand, the introduction of this species may not have played any role, but merely increased urban biodiversity in quantity. In this case, these species still exist only as a landscape and do not form a harmonious and unified relationship with the city's artificial environment, urban residents, and urban native species. It is necessary to analyze the urban original

community to ensure that the introduced species do not conflict with the original community. Aboriginal organisms, as some species that have survived in cities for a long time, have adapted to the city's artificial or semi-nature environment [14]. And living with the human group, urban species will also have some adaptability in life habits, more adapt to urban life. In addition, it is also necessary to analyze the introduced biomes, the living environment of the introduced biomes and the corresponding natural enemy threats, and the symbiotic and exclusion relationship between the introduced biomes and the urban indigenous species.

Organisms introduced into the city also can be integrated with the city's infrastructure (Fig. 6). This combination does not mean that nature exists as a landscape. Instead, nature has assumed a certain function during the entire city operation, and this part of the function that nature assumes will reduce the use of other facilities and proportion of energy supply. Biology and urban infrastructure form a unified whole, and jointly assume corresponding functions.

Fig. 6. Integration

4 Discuss

This paper mainly lists several paths and possible directions of biological design for different urban areas and environments, and analyzes how these directions can be designed through some cases. Significantly, biological design has great guidance and reference in the field of urban sustainable ecological construction. By analyzing the relationship between design and biology to discuss biological design, the design process can be more and more clear. This paper focuses on urban sustainable ecological exploration mainly in several aspects, urban resilience, urban biodiversity and urban environment. Through some conceptual explanations and case studies, some new ideas are provided for the sustainable development of the city in the future. Sustainability of a city is a very ambitious vision. It requires overall planning, coordination of resources, and long-term goals. As a tool to coordinate biology and the environment, Bio-design will play an increasingly important role in urban sustainability.

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Ergonomics in Building and Architecture

Public Space for Active Senior

Joanna Jablonska(✉) and Elzbieta Trocka-Leszczynska

Faculty of Architecture, Wroclaw University of Science and Technology,
B. Prusa 53/55 Street, 50-317 Wroclaw, Poland
{joanna.jablonska,
elzbieta.trocka-leszczynska}@pwr.edu.pl

Abstract. According to predictions about 30% of people around 2060 will be over the age 65, while age of 80 year and more will be achieved estimated by 12% of European Union population. Elongating life expectancy, low birth rate and aging of baby boom generation, forces on governments, authorities, politicians and economists, change of their approach towards policies, work market, but also in relation to cities' development and management, especially in the range of public spaces. Seniors are economically and culturally active members of society, thus spatial planning and urban solutions, should be changed towards they needs and expectations.

Keywords: Ergonomics · Public space for active seniors · Seniors in urban and architectural design · Contemporary ergonomic solutions · Accessible urban space

1 Introduction

Population of Europe and USA is aging rapidly and thus seniors are becoming subject of interests of economists, investors, developers and increasingly of architects and urban planners. It comes as no surprise, taking into account the numbers, stating that since 2013 about 18% of Europeans is over 65 years old and 5% over 80 and this parameters will reach accordingly 30% and 12% by 2060 [2], while one third or one fourth (dependent on a source) of Americans will be over 65 by 2050 [4, 7]. New society of old continent, may soon consist substantially of well educated, interested in travels and development older people, active and willing to do sports, probably with money to spent on their needs and pursuits [8]. Shaping of such city and village for future residents is designers present and boom of new approach examples towards public space for everybody was observed in the last five years, yet this process still requires a lot of attention from authorities and city planners [6, 11].

Purpose. In light of aforementioned issues main purpose of this article is to show and analyze existing solutions, in order to evaluate their ergonomic and social usability, but also how well they serve their main aim. Next goal is to show which of diagnosed elements should be extended towards future and promoted and to state which elements are still missing, and should be introduced into the design.

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Scope. Elderly people are a group of cities and villages residents, who are especially threatened by loneliness, isolation, health problems and sedentary lifestyle. What is more there is not a sufficient number of parks designated especially for them – despite occasional bench or an open-air chess board [7]. Such solutions still promote sedative life-style, discouraging any other activity type. Hence, the scope of this article was general and case study for practical, real life solutions implemented in Europe.

Method. Studies were conducted on two levels: literature review – consistent on newest publications in this respect and case studies – carried out by authors *in situ*. Important data were gathered on the official producers websites and platforms, where devices and solutions for seniors are presented with their technical data. Findings have been recorded as graphical and descriptive material and after analysis and critical analysis where presented in this elaboration. Conclusions – here in the form of recommendation list – have been formed in the process of synthesis, cooperative synthesis for both literature and studied cases and after critical overview most important indicators were presented.

2 Discussion

There are different needs that public space adjusted for seniors should respond to. Starting from fruition of interests of people, who already retired their work, and have time to pursuit their passions, i.e. photography, painting, sports, social contacts, etc. Finishing at enabling these activities in a safer, friendly environment, during these period of life, where physical and mental capabilities may be more challenging. There are several issues that might be dealt with, like: health problems, among them weakling of sight, hearing disabilities, sensory disorientation, psychological limitations including depression, mobility confines, increasing feeling of insecurity, danger from surrounding environment and others, lack of ability to adapt to changing conditions, accompanied by a strong need for independency and pride [3]. Taking account all these factor there are several aspects that must be taken into consideration, while discussing public space adjusted for seniors, these are, as listed: diversity, greenery, safety, social and location.

Diversity – seems to be a main characteristics of older European and Americans, which states the obvious, as we all come from different: education, cultures, customs, needs and preferences [4]. Also depending on work characteristic (either currently performed or before retirement) and health condition, people may seek more rest and meetings in public spaces or extra sport and physical activates. Thou, trivial in order to success with the public space design – diversity and the key factor – must be included in further considerations. What is more it is predicted, that nearest feature seniors will not be willing to spent time in their own age groups, seeking for more integrational activities [8].

Greenery. Next factor, clearly indicated by the sources [4] is greenery, well kept, blooming and massive in form, is important and noticeable element for the seniors. What is more contact with nature has been proven a healing factor and at the same time

it favors to reduce stress, blood pressure and overall physical and mental tension, helping contemplation and relaxation [7]. Substantial green terrains: cool down the climate, clean air and can be used as dancing, yoga, tai-chi or dog walking areas. Thus, seems especially crucial, when we take into account need for fresh air. Greenery seems also to be important binding element, especially in the form of community or herbs gardens, allowing users to integrate over some gardening activities and information exchange about plant growing expertise.

Safety. Though, safety seems to be another obvious factor, security for elderly in is not only lack of threats from other users but also visibility – of paths, of utilities and facilities and minimization of risk of falling – so types of flooring, lack of natural surface bulges or curbs and low, hard to see fences etc. What is more as Mazur states, omitting of boundaries – helps engaging spontaneous conversations, engaging relationships, prevents psychological and as it was mentioned physical barriers. Area is also easy accessible, because of soft, natural flooring – grass and lack of high curbs. Walk ways should be wide, even, but not slippery. Another crucial element of safety is legibility, which allows users to read and understand space, in order to gain clear orientation and familiarity – areas easy to understand, i.e. basing on previous experience. Aforementioned lack of boundaries should not be understood as omitting of terrain functional separation, so pedestrian communication must be clearly manifested towards areas for seating, relaxation or activity equipment usage, at the same time any bike routs or car traffic passages ought to be very clearly marked. The contrast is advised, for color differences might not be noticed by some seniors. Apart from that, health safety can be increased by maintains of cleanness of public spaces by lack of rubbish but also animal droppings [1, 3, 4, 9].

Social. Another, non-less important factor for creation of good public space, especially for elderly is providing space for meetings, talks, experience exchange [1], but also common walking, dog walking, dancing or open-air exercises (park yoga, tai-chi groups). Which might be specially beneficial taking into account cultural diversity of specific European and American areas, but also is a great factor for building strong and supportive local communities and in counteracting loneliness, isolation and depression phenomenon between seniors.

Location. What is also stressed in literature sources [1] in need for closeness of additional services – like shops, workshops, etc., which allow to accomplish other social need of seniors, during one exit from home. At the same time public spaces for seniors should not be placed by loud, hard to cross streets and other communication routes (i.e. tram lines, fast bike roads), not only for safety but also from acoustic reasons. Acoustic barriers are advised, in the most severe cases of noise [3].

3 Case Studies

Polkowice – Residential Area Between Block of Flats. A great example of aforementioned problem solutions would be city of Polkowice in Poland. Where at the grassy terrain between existing blocks-of-flats (erected during the modern period),

where a substantial number of older people live, there have been settled not only spaces for children, but also seniors. The daily relaxation and sport hubs, have been established as a part of remodeling of modern period empty terrains between residential blocks [12]. A set of sensory activation equipment have been arranged here on the area covered with grass. Selection of different devices is available, which were designed with the physical rehabilitation experts, as producer declares [10]. One of the most interesting solutions is an exercise device set – based on rope walkways – that enables variety of exercises. What can also be noticed are comfortable, safe handles, which enable support during the walk through all device (Fig. 1). Seniors can use as well the wavy rail, for arm activation and motion. Also a high ladder can be found there, that is designated for finger stimulation. Next would be a circle, where hand and arm exercises are easy and guided with the device aid (Fig. 2). Elements are thick, safe, stable and provide easy grip, in all possible positions. Among those others can be found like: balance beam, rails and arches for arm motion, steppers with additional safety handles designed in easy grip manner [10].

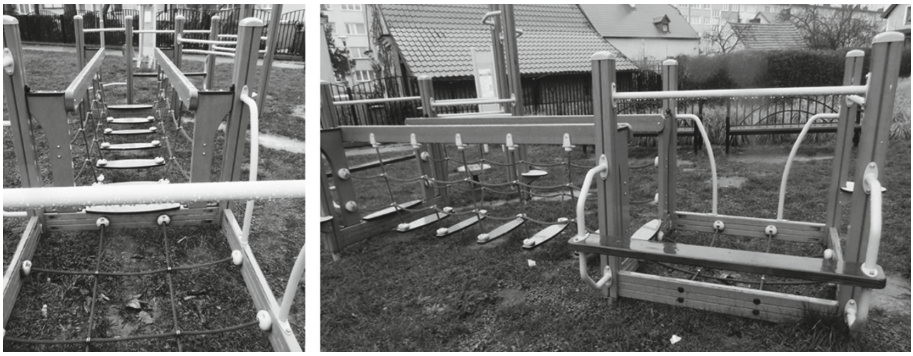

Fig. 1. Polkowice (Poland). Exercise device for people with disabilities and older adults.

All equipment is well exposed and visible, there is enough operation space between elements. Colors used for described devices are vivid, yet suitable for grown-ups: bright and toned greens, browns, orange and dark blue (not as stimulating as for children), and equipment can be at a glance recognized by their potential users. Although there are some metal elements used, their surface was treated in a way not to heat and not to produce glares. Such equipment benefits not only the physical health, but also lowers the risk of dementia and other cognitive impairment [7]. What is more sensory activating devises are strictly connected with open-air gym, which can both serve seniors, as well as providing them social interaction with younger and older adults. What can be noticed in this example is lack of fence around space solved in this way, which favors limited mobility – space can be accessed from each possible spot – according to the comfort.

Next important solution was found in Stalowa Wola (Poland), where on the playground, but also space meat for young adults and adults, swing was settled designated for people moving on wheelchairs. Device has proper operation surface, mobile

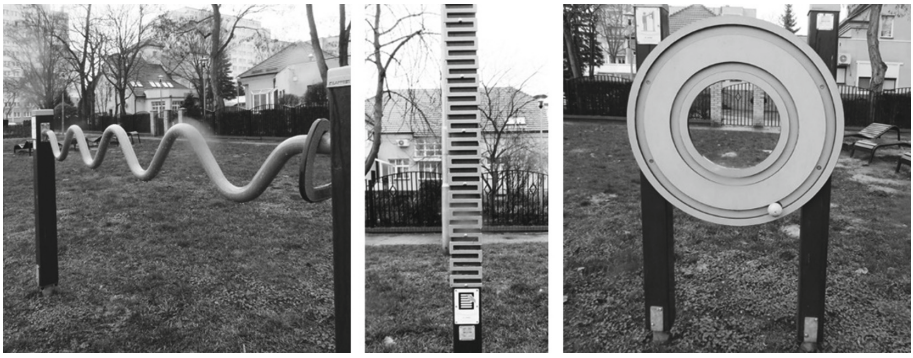

Fig. 2. Polkowice (Poland). Movement activating equipment.

driveway (that must be closed for users safety) protection barriers and handles. It can be operated individually and does not require aid form third party. What was also memorable about this case study, was very clear, readable tables with additional description concerning device (Fig. 3).

Fig. 3. Stalowa Wola (Poland). Swing for people moving on wheelchairs. Clear description.

Next case study was carried out in Copenhagen (Denmark) public square Israel's Plads, which is a design of Sweco Architects + COBE. Idea was inspired by urban changes that city went through – like fortifications, than trade market and a parking. Currently, cars are placed bellow this space, while the surface can serve all possible users, with playgrounds, flooring elevations and pilings up, area for ball games, sport field, greenery and a number of equipment and devices for activities. In that matter especially interesting are sculptures swings (Fig. 4) and paths (Fig. 5) – enabling to exercise movement, dependent of physic capacities [5].

Important element is flooring, which is flat, yet it contains raised and lowered elements, carefully thought through, adjusted to potential users (sports men, children, youngsters). At the same time all square is adjusted for people with disabilities, which

Fig. 4. Copenhagen (Denmark) public square Israels Plads. Sculptures exercise equipment.

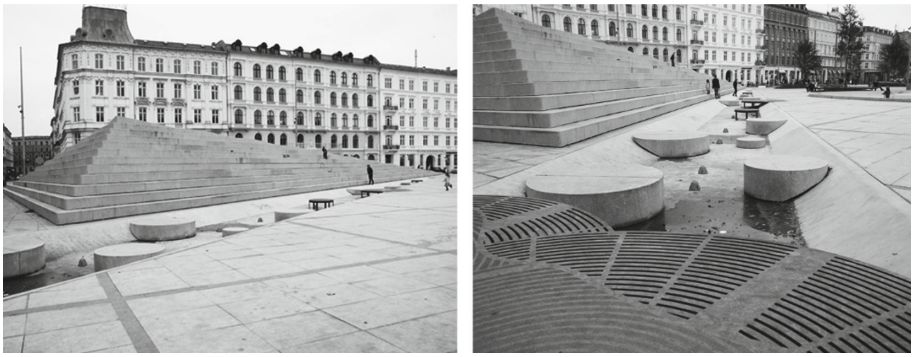

Fig. 5. Copenhagen (Denmark) public square Israels Plads. Paths for movement exercises.

is specially visible in gentle and elegant marking of charges of height or material. The water is properly drained from the surface, due to which no puddles are formed and all utilities can be kept in good condition for a longer period of time. All "toys" are well install, safe, without any dangerous parts and are very well maintained.

4 Conclusions

In light of aforementioned consideration, basing on case and literature study, a list of recommendations have been formed for open-air public spaces:

- proper location providing: good natural lighting, shading during the high air temperatures periods; quietness and lack of loud sound level production areas (i.e. sport zones, open-air concert venues, schools, etc.); large greener areas (for running, sports, yoga, dancing and clean air), even terrain without distinguished slopes and hills; area with low noise levels;

- lack of physical barriers in form of: fences, raised curbs, unfavorable (uncomfortable) flooring; additional handless and arm rests for equipment which may require additional support;
- activation points – encouraging spontaneous fun, physical activity or conversation: resting solutions with ergonomic adjustments for elderly, like: benches, seating, sunbeds, hammocks; physical and mental exercise equipment adjusted for seniors;
- additional unphysical factors: provision of sense of independence and at the same time safety; providing lack of isolation; good, ethical look of all equipment, i.e.: all furniture, minor architecture elements and equipment must be: resistant to weather conditions, vandalism acts; local and natural materials;
- safety of users: all elements ought to have a proper structure and be easy in maintaining and in control of technical conditions throughout time; monitoring if needed;
- walking areas, with both activation and rest elements;
- good visibility: including evening artificial lighting (evenly spread); avoidance of glare creating materials and surfaces; clear sings and texts;
- facilities: drinking fountains and water bottle fillers; sufficient number of adjusted public toilets; places, space and devices for animals.

Final Conclusions. Adjustment of space for seniors, people with different kind of disability, serves everyone – all city and village users, proving safe, comfortable solutions, beneficial to physical and psychological health. There are already a number of good practice examples, which can serve for future reference and as examples to other communities. Well organized spaces, are becoming vibrant meeting places, encouraging relax, entertainment and physical activities, enabling adults and seniors to balance all aspects of their life, making public space humane and user friendly.

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Ergonomics of Architectural-Acoustic Solutions in Contemporary Offices

Joanna Jablonska(✉) and Elzbieta Trocka-Leszczynska

Faculty of Architecture, Wroclaw University of Science and Technology,
B. Prusa 53/55 st., 50-317 Wroclaw, Poland
{joanna.jablonska,
elzbieta.trocka-leszczynska}@pwr.edu.pl

Abstract. Properly designed architecture and acoustics is one of the crucial aspects in contemporary ergonomic offices, which should state a safe and humane work environment, experienced by employees and employers on daily basis. Strictly connected to formal, functional and material architectural solutions, sound field perimeters are becoming one of the main aspects of currently formulated norms and standards, which are especially dedicated to specific types of these work places. However the subject is yet broader and considers not only large scale open areas, but also cell-offices, combined solutions, active (mobile) layouts, etc. Thus, this article was devoted to study on shaping architectural acoustic of contemporary office in respect of ergonomics.

Keywords: Ergonomics · Office design · Architectural acoustics · Contemporary ergonomic solutions · Office ergonomics

1 Introduction

Ergonomics is a science related to principles and methods of adapting devices and tools to human physical and mental characteristics [18]. Notion was established in 1857 by Wojciech Bogumił Jastrzębowski in polish journal (based in Poznan city), where in the article titled: 'An outline of Ergonomics, thus Science of Work based on disciplines taken from Natural Sciences' (from Polish language: 'Rys Ergonomii czyli Nauki o Pracy opartej na naukach poczerpniętych z Nauki Przyrody'), where it was derived from terms *ergon* (work) and *nomos* (law, rule). He also claims, that Science of Work, understood as using the powers and capabilities was given directly to human being from Creator [11]. Elaborated notion has also contemporary definition given by International Ergonomics Association, which is as follows: 'Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance. Ergonomists contribute to the design and evaluation of tasks, jobs, products, environments and systems in order to make them compatible with the needs, abilities and limitations of people' [7].

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One of the architectural spaces, where all aforementioned factors come together are office spaces, nowadays one of the most common contemporary work places. Adaptation to mental and physical human needs are required for both work environment to ensure work comfort, as well as all components of office space, which can significantly affect the efficiency of office work. One of such components is acoustics solved in relation towards architecture.

Purpose. In light of arguments outlined in the introduction, the subject of presented study is acoustics in an open office space (and in particular within a workplace placed in such space), and this article was devoted to present findings on ergonomics of office work places. Main aim of these article is to reveal specific problems that occur in office design in aspect of acoustics, especially in the range of open plans. The sound phenomenon in such areas, is hard to predict and control, even taking into account norms and standards. Moreover said spaces usually must be very elastic in respect towards arrangement options, thus the designer predications are even more complex. Secondary aim was to show solutions, which would be most beneficial in open plan office architectural and acoustical design. The guidelines had also to be universal and applicable to variety of cases.

2 Problematics

The comfort of office work includes: ergonomic design of interior and equipment, care for the minimal noise level and proper lighting, including colors and textures of finishing. These components can influence and complement each other and if properly shaped and arranged, can improve both acoustic conditions and effects of work, providing friendly and comfortable environment.

Historic Outline. So called 'open space offices' were created in the 19th century and were called American large-scale (indoor) offices, due to their first locations in Chicago and New York. In these bureaus, for economic reasons, there was a significant concentration of work places, which, with a large number of noisy typewriters, created uncomfortable, even inhumane working conditions. This situation changed following designs aimed at improving the conditions of office work, among them 'landscape offices', introducing various layouts of work stations to the interiors – corresponding to the horizontal organizational structure and at the same time enabling more employee privacy and noise limitation. Offices of this type developed in Europe in the 1960s, bringing a significant improvement in work comfort by introducing: ergonomic equipment (armchairs, desks, quiet devices), care for proper lighting (suspended ceilings) and reduction of noise levels (floor coverings, suspended ceilings, greenery, sound absorption screens – concealing and separating work stations, etc.) [13].

Contemporary Problematics. Paying attention to the appropriate acoustic conditions in large-scale offices, it is noted that the noise main source within are conversations arising from carried out work specifics, i.e. from group task, in which it is necessary to ensure the communication of employees and speech intelligibility. Next factor is individual work – requiring a low level of acoustic interference (shielding) in connection with the need for

significant focus and concentration. An additional source of noise are also various types of equipment: computers and keyboards, printers or scanners, as well as ringing telephones, beeping Smartphones and tablets or often installations (air conditioning, ventilation) and communication elements (elevators, escalators) and communication routes running through the office. All these factors and their enhancement caused by reflections from walls, ceilings, compartments, windows, etc. are called **reverberation noise** [17, 20].

Noise is even more significant, while taking into account number quoted in Steelcase research, derived in 17 countries, in which 85% of employees working in open space offices, declared, that they find workplace too loud. Different study in 8 selected companies, showed that 31,6% of workers declared improper acoustics [5]. High noise levels negatively affect people working in it, causing: stress with risk of turning into a permanent phenomenon, hearing weakling and impairment, lack of concentration, memory problems, constant tiredness and in effect some people may experience systems diseases like: digestive problems, musculoskeletal, endocrine, nervous (anxiety, dissatisfaction, irritability and lack of emotional balance) [1, 20].

Needs. According to Mikulski [14], working in an open space office requires an increased acoustic standards, including, minimal levels of background noise, intelligibility of speech between two people (works, client and worker), who should not interrupt further workstations. Also Polish Norm PN-B-02151-4 [17] in reference to proper reverberation condition and speech intelligibility introduces several notions so-called: maximum reverberation time T (international: RT), acoustic absorption A and STI speech transmission indicator. Typical solution for these problem, is usually carpeting on the floor and at occasions absorbing suspended ceiling or some acoustic system treatment on the walls. Yet, research carried out in this respect show, that such solutions are not sufficient for contemporary needs. Just to recall Mikulski's [14, p. 11] 'pilot tests and acoustic evaluation': 'Standard acoustic treatment, containing sound absorbing suspended ceiling, sound absorbing materials on the walls, carpet flooring and sound absorbing workplace barriers, is not sufficient. These rooms require specific advanced acoustic solutions'.

3 Certificates and Standards

Noise in Certificates. Noise problem is generally handled in certificate policies meant for creation of healthy building, in practice used especially for office buildings, i.e.: BREEM, LEED, Active House, The Living Building Challenge, AktivPlus, DNGB, which are basically focused on indoor air, light, building and finishing martials parameters, design and quality [19]. To give an example, in the first one, main focus is placed on protection from existing and potential noise around the site, as well as from negative sounds that could be produced by future building appliances or its' users. Also, on the 'noise conflicts', that could appear between building inhabitants. This statement is optimal and covers the normative demands. In the practical perspective, BREEM technical manual requires a noise rapport to be carried out by the properly qualified acoustician, followed by optimized indoor solution providing proper inner conditions according to the BS8233 or other applicable documents (manual refers to

different continents and countries). Based on how well these conditions are achieved – according to given criteria – proper rating of the acoustic ambient is awarded – with one, two or three credits [4]. LEED certificate, which is used world-widely for green buildings [19] also recalls the need for acoustic performance, referring to: the international standard connected to the sound measurement: IEC 61672-1:2013, standard from 2011 AHSRAE Handbook—HVAC, 2015 ASHRAE Handbook—HVAC Applications, NIC option for sound transmission and others [10]. Yet the clearest recommendations in this respect can be found in norms and standards devoted to acoustical space design.

Required Parameters. Therefore, tasks for designers aiming to improve acoustic comfort in open space are not only limiting the noise level to the basic requirements, where: permitted sound level A (measured in dB and corrected according to the curve A) – offices for private conversation and directors cannot be more than – 30 dB, individuals – 35 dB, for open office – 40 dB. At the same time there is a need for limitation of reverberation time in the following frequencies: 125, 250, 500, 1000, 2000, 8000 Hz or increasing of sound absorption, which can be calculated by formula according to the surface of the room (i.e. formula can be obtained from Polish Norm PN-B-02151-2 [16]. But at the same time, designers should aim at achieving more, i.e. providing special acoustic solutions that will allow equating working conditions in small rooms 'cells' with acoustic conditions in open spaces, because usually the requirements for employees are the same.

The improvement of acoustic conditions brings many benefits, such as: reducing the workload and its burden, increasing work efficiency, facilitating communication between employees and ultimately improving the comfort of work and the well-being and health of employees.

4 Solutions

Various types of solutions, that aim at both distinctive, elegant design and functional solutions – privacy, acoustic performance are elements that can complement arrangement of office space. The other issue that architects can aim for is biophilic design a trend using natural greenery in interiors, natural materials in combination with proper lighting parameters, thus increasing air and sound room quality [21]. By connecting all these element together and basing on data sources, a list of several recommendation was formed and it is as follows [1, 2, 8, 15]:

- acoustic ceilings with broadband ceiling absorbent possibilities (sound muting for wide range of frequencies), made of perforated metal or plywood panels, filled with proper materials i.e. mineral, glass wool (secured from fibre emission), or press mineral wool modular ceiling panels, including lighting elements and serving installation and ducks masking,
- walls or wall elements constituting broadband wall absorbers (vertical and horizontal), and: walls of different heights, free-standing screens (at occasions transparent, better filled-in with airborne sound insulation), panels of soft polyurethane foam (only those, that are fire proved), cork, felt of various forms (sometimes

artistic), thick curtains (often as decorative elements of interior design, best double-layered) (Fig. 1),
- acoustically absorbent floors, i.e.: carpeting, rugs (adjusted for people with disabilities)
- so called acoustic furniture, so furniture equipped with sound absorbing walls, fronts, and within telephone booths, named 'acoustic booths' (complemented with a larger area) – limiting the propagation of noise from telephone conversations (Fig. 2),
- equipment with additional functions, such as lighting combined with acoustic panels or desktop panels, desk equipment components (Fig. 1),
- decoration, i.e. paintings, sculptures, acoustic active wall art,
- greenery: free-standing, combined with: furniture, walls, screens, elements of equipment (not taking up office floor space), also connected to aforementioned biophilic design, but also structural elements and shelves meant for greenery support (Fig. 2).

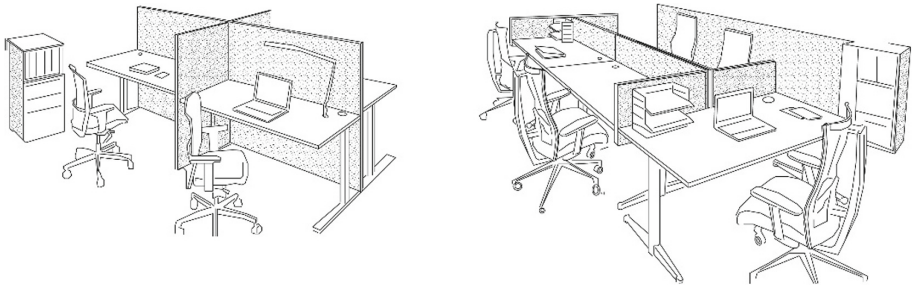

Fig. 1. Acoustic partition from right: between desks screens with absorbent elements on furniture; on desk screens, additional elements on walls and furniture [drawn by authors, based on: 3, 9]

Apart from aforesaid, designing the proper work space – for an individual employee within an open space arrangement – will also require proper placement of furniture within the workstation and in relation to neighbouring desks. Crucial is correct set up of acoustic screens, providing cut off and obstruction of interfering sound sources, i.e. communication routes, equipment stations. Next is opening space towards those positions of people, with whom the employee must communicate by voice, or to open views in order to i.e. supervise the group work or for greenery providing relaxation. It is also important, that screen placement does not reduces natural or artificial light below required levels. In the case of managerial positions, so that free conversations with clients can be conducted, attention should also be paid to the arrangement of adjacent work stations, acoustic elements and furniture, as well as greenery. The goal is not to place other workplaces within the speech clarity limit and not to place staff from other teams, in those spaces, where still conversations may be heard [13]. Of course these boundaries will be different for varied cases dependant on: arrangement

and finishing of office, sound absorbing suspended ceilings reverberation time, speech transition indicator, and such. Moreover, ceiling should be designed in way, to limit sounds reflections distribution outside the zones protected by the limit of clarity and audibility of speech [13]. Fortunately, particular needs can be measured *in situ*, before detailed arrangement.

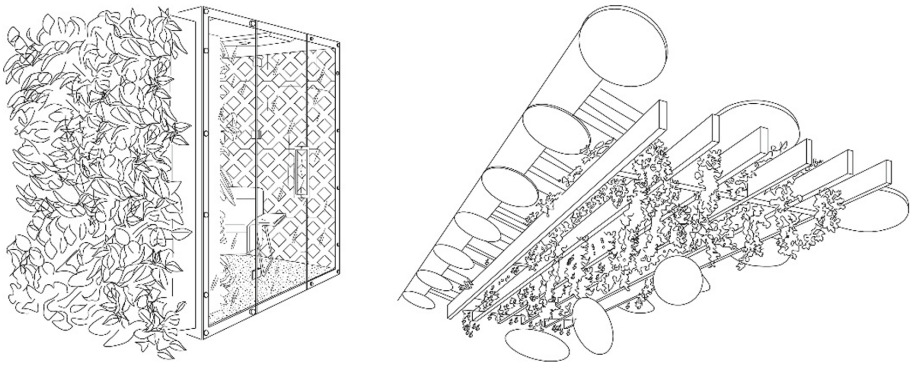

Fig. 2. Acoustic solutions for offices, from left: telephone both with biophilic and acoustic walls inside-outside and absorbent solutions on the ceiling; suspended elements – absorbent islands and sub-structure with greenery; [drawn by authors, based on: 6, 12]

5 Conclusions

Open office design in case of ergonomic solutions is complex and multi-thread enterprise, in order to obtain: workers comfort and safety, optimal parameters of acoustic field, fresh air and proper natural and artificial lighting. Yet, as it was aforementioned there is a number of design concepts and solutions, that allow providing favorable conditions and humanized environment. Summarizing aforementioned consideration, it is stated that first one is partial spatial division – with screens, telephone cabins, artistic arrangement, green partitions (connected to biophilic design) and second is placing sufficient amount of absorbing material, with the use of self-made or ready-produced acoustic system, i.e.: suspended ceilings, absorbent flooring, wall elements, additional material for aforementioned partition screens, etc.

Combination of two methods – division and absorbance – can provide substantial solutions for contemporary, user friendly office, with more efficient and less nervous employees and managers. Especially combination with greenery, seems to be new and favorable design tendency of the future.

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Ergonomic Design of Private Outdoor Living Spaces

Przemyslaw Nowakowski(✉)

Department of Architecture, Wroclaw University of Science and Technology, Prusa st., 53/55, Wroclaw, Poland
przemyslaw.nowakowski@pwr.edu.pl

Abstract. In urban environment, as well as in individual interiors, the access to outdoor spaces is very important, especially to green and sunlit areas, and areas with a sky view. These closed functional sections are therefore complemented by public and private spaces open to the external environment. The opening of residential spaces to the natural environment is particularly preferred. In multi-family housing, it is possible mainly thanks to the use of adjacent balconies, loggias, etc., which provide the opportunity to stay outdoors, but still within a private residential area. The paper discusses such issues as: types of private external spaces, their aesthetic and structural shaping, their relationship to internal sections and other rooms, the conditions of their construction in the vicinity of already existing and designed dwellings, the advantages and disadvantages of analyzed solutions (case study) and recommended ergonomic design criteria, taking into account the general and specific housing needs (including those of people with disabilities).

Keywords: Architecture · Ergonomics in architectural design · Housing design

1 Introduction

A modern house consists of a lounge area (rooms) and service area (entrance hall, kitchen, bathroom). The functional and spatial program of a house is diversified by the intermediate zone between the indoor and outdoor space (balcony, loggia, terrace), which provides the opportunity to spend free time outdoors, however, within a dwelling.

Balconies and loggias consist an important element of shaping the body of a building, which, as a result, becomes more spatially differentiated; the layout of light and shadows on the facade is varied and dynamic. Moreover, additional façade forms allow the use of different building materials, surface textures and colors.

Direct outdoor access is an important criterion for choosing a dwelling. For various reasons, balconies or loggias are oftentimes very small and do not meet users' expectations. Their quality is also influenced by various factors independent of the housing standard, these include, above all: climatic conditions, sun exposure, as well as location in relation to neighboring buildings and dwellings.

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2 Trends in the Shaping of the House Outdoor Space

In countries with mild and warm climates (including the Mediterranean countries), weather conditions are favorable for spending time outdoors. Therefore, housing open to the outdoor environment were already known in the ancient times. Even today, large terraces, balconies and even roof tops are used for recreational purposes there.

For centuries, residential houses with balconies or terraces were rarely built in Poland and other Central and Eastern European countries, as, at that time, they were considered to be mainly an element shaping the architecture of the building [2]. Their subordinate utility role was determined by both climatic conditions and lifestyle. Strict etiquette of i.a. fashion did not favor informal outdoor activities. Private and, with time, public gardens and parks were places of recreation and play. What is more, the intensification of development in large cities was the reason for the lack of private space outside dwellings. Balconies, terraces, arcades, etc. were more characteristic of palace and manor buildings of the richest social groups, while residences surrounded by greenery (with private parks and gardens) were located outside the city centers.

Overcrowding and tight urban development (especially in the 19th century) led to poor hygienic and sanitary living conditions for the majority of population. The outdoor space of the tenement houses was limited to narrow balconies on the front side (from the street) and to narrow courtyards at the back of tenement houses which included owners' apartments and dwellings in outhouses rented to worker families. Due to poor sanitary conditions, many community activists and scholars criticized the then urban development model, overcrowding of dwellings and lack of free recreational area.

After the First World War, the postulate of improving hygienic conditions gained in importance. Among others, many housing estates for less affluent dwellers were built. Thanks to lower building intensity and surrounding the buildings with greenery it was possible to provide better natural light and sunshine of apartments, as well as improve their functional and spatial diversity by using terraces, balconies, galleries or home gardens (Fig. 1). Such design decisions were then justified primarily by preventive care [3].

Fig. 1. Terrace with a pergola and private garden by a worker house (Wroclaw 1926) [5]

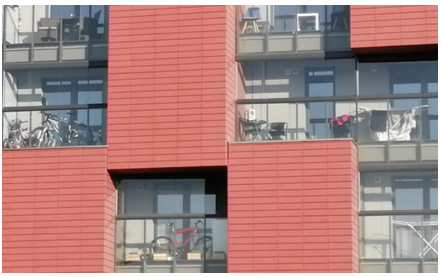

Fig. 2. Narrow balconies as a space used only for e.g. drying clothes or storage of bikes and various equipment (photograph by the author).

The pre-war concepts of building housing estates and apartments with access to green areas continued after World War II. Numerous apartments built at that time had a balcony or a loggia. However, due to economic reasons they were often replaced by the so-called French windows (porte-fenêtres), or new buildings were built without these elements at all. That is why, such buildings are called "blocks", as they look like rectangular boxes. In this case, the important architectural values (material, structural, aesthetic), which are provided by the use of additional spatial forms such as balconies, were not appreciated.

In post-war residential buildings the actual depth of balconies or loggias is usually about 120 cm. This is due to cost-saving and technological reasons (using e.g. large block and slab technology) [6]. In such case, a narrow balcony or loggia cannot be used effectively for recreational purposes, as it is not possible to set up a table with chairs or a sun lounger and as a result, oftentimes those spaces are used merely as additional storage space (Fig. 2).

A significant part of the housing stock is made up of historic tenement houses erected at the turn of the 19th and 20th century. Many of them have original balconies on the front side, stylishly matched to the decorative facades, however, they are also narrow. Exposure towards the street (even from the north) is not conducive to maintaining a sense of intimacy, and the longitudinal proportions hinder freedom of movement. On the other hand, from the courtyard side, tenements usually did not have balconies at all (Fig. 3), as they used to be covered with outbuildings. Many housing communities (especially in Germany) are currently undertaking modernization works and construction of balconies on the courtyard side, where the flat façade has no significant historical value (Fig. 4). Similar actions are also taken on housing estates built in the large plate technology.

Appropriate arrangement of the re-assembled structure often requires taking into account certain restrictions related to the ownership division of the plot and the apartments themselves, as well as to fire protection conditions (ensuring adequate spacing to prevent the spread of fire). Therefore, in many cases, balconies are not accessible from any room, but from the kitchen (Fig. 5). As a result, they lose their role as a functional extension of a room. Nevertheless, the adjacency of the kitchen offers other advantages, as balcony is an ideal place to eat outdoors on sunny days and it can also be a place to grow herbs and spices (and even vegetables) used in meal preparation.

Fig. 3. Elevations of tenement houses from the 19th/20th century on the courtyard side without balconies (photograph by the author).

Fig. 4. Contemporary balconies of steel construction at a historic building (photograph by the author).

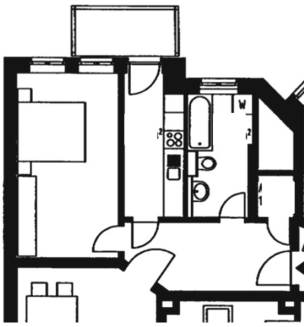

Fig. 5. Arrangement of balconies in the building design with access from the kitchen (image by the author).

3 Functions of House Outdoor Spaces and Their Design Criteria

In temperate climates, balconies and loggias seem to have little importance in the functional and spatial design of apartments, especially in comparison with Mediterranean architecture. Nevertheless, when such spaces are properly designed, they are willingly used by residents during warm days and evenings.

Smaller apartments (especially studio apartments) often do not have balconies or loggias, which are available in one-bedroom and larger apartments. In this case the factors which are taken into account are savings, as well as climatic and aesthetic requirements (architectural design of façade forms).

Joining of the housing space and the surrounding environment may be both direct or indirect, and it is achieved through:

- indirect visual contact using a transparent surface in the form of a traditional window, the so-called French window (porte-fenêtre) or flower window;
- direct visual and functional contact with the outdoor environment through balcony, loggia, terrace etc.

Balconies and loggias enable taking over the functions of a living room on warm days and evenings and joining of the living space with the outdoors. They can be considered as a space extending the living room or children's room [4, 7], as well as providing the possibility of meeting such outdoor needs in the open air as:

- passive rest (e.g. sunbathing, meeting with family and friends);
- active rest (e.g. gardening, exercising);
- children's play;
- contact with nature (limited in the city or in tall buildings);
- cultivation of potted greenery (flowers, herbs).

Open spaces significantly increase the comfort and standard of apartments, especially those in multi-family houses. Significant intensification of urban development, and its erection oftentimes in the midst of greenery, create favorable conditions for complementing the apartments with balconies, loggias and terraces, and sometimes even with home gardens, which are an important addition to the living rooms, by being able to take over their functions during warm days and evenings (Fig. 6). The favorable location depends on their sunlight exposure and connection to adjacent rooms. It is recommended to place them on the south or south-western side of the building, provided the outdoor spaces are not shaded by neighboring buildings. Moreover, they should be acoustically isolated from the street noise and provide privacy, as well as be a buffer zone, protecting against external noises caused especially by car traffic. It is recommended to shelter such outdoor areas against wind, rain and excessive sunlight. Loggias are less exposed to sun than balconies and the adjacent rooms are enshadowed during the summer season. Covering the side walls of a loggia is more advantageous for the users than balconies exposed to annoying external factors (sunlight, noise) [1].

Efficient use of a balcony or loggia requires the provision of usable area, which is necessary to set up the essential equipment (table, chairs, deckchairs, etc.) and entry space (Fig. 6). Apart from the size, the shape and proportions of the space are also important, as significantly large but narrow balconies (depth below 120 cm) are not used effectively, oftentimes becoming a storage area or a clothes drying space. Therefore, balconies and loggias should be no less than of 150 cm depth, allowing them to be furnished in several variants and used by people with disabilities (Fig. 6).

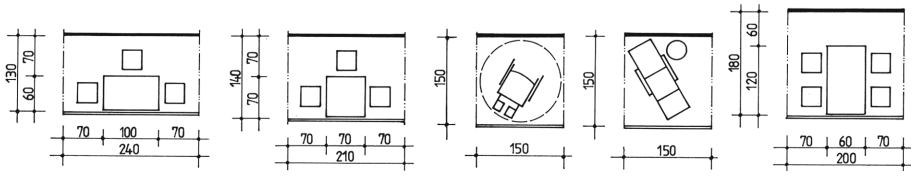

Fig. 6. Examples of balconies with different depths and their arrangement (image by the author).

Designing of outdoor living space should always take into account safety issues. The floor (even when wet) should prevent users from slipping and its appropriate slope should allow for quick drainage of rainwater. A stable railing preventing from falling

out should allow to look outside easily, while protecting the interior of the apartment from the insight of onlookers. What is more, its structure should particularly protect children from falling out.

Some apartments located on the ground floor of the building have terraces and home gardens and such a solution makes their functional and spatial program much more attractive (Fig. 7). Flats with adjacent gardens may be designed especially for families with many children, the elderly and people with disabilities (especially those on wheelchairs). However, such a solution requires appropriate architectural treatments, protecting the garden and the adjoining apartment against burglary and onlookers. It is therefore recommended to use, among others: fence nets, hedges, steep slopes between the terrace level and the adjacent area, burglar-proof windows, doors.

Fig. 7. Principles of spatial shaping of home gardens in relation to the level of housing and public space (image by the author).

Outdoor spaces are sometimes considered as vulnerable spaces in terms of anti-burglary protection (Fig. 8). This applies especially to ground floor apartments. The feeling of security is improved by individual (usually arbitrary) separation of space using grids. Through this measure, however, residents lose direct contact with the outdoors, and such bars also create unnecessary optical barrier.

4 House Outdoor Space for People with Disabilities

House outdoor space plays a significant role in the home life of people with disabilities, as depending on the degree of disability, it can become the main or sole place of contact with the outside environment.

Balconies and loggias are an important place of contact with the outside world for people with disabilities, accessible at any time, without having to leave the house. In many cases, they give them the only opportunity to be outdoors for long stretches of time. For this reason, it should be possible to enable spending time there even in adverse weather conditions (rain, wind, coldness, or heat). The size of the balcony or loggia enabling the proper fulfillment of the relaxation function, depends on the appropriate area, shape and proportions of the space (including the necessary wheelchair maneuvering space), as well as, among others, the way the space is arranged and the dimensions of the equipment (Fig. 9).

Fig. 8. Balcony grids as additional protection against burglary (Shenzhen, China, photograph by the author).

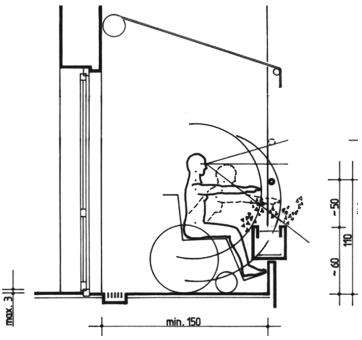

Fig. 9. The principle of balcony design for people with disabilities (image by the author).

Ergonomic design of the apartment outdoor space taking into account the needs of people with disabilities requires, among other things, meeting the following requirements:

- balcony doors with a suitable width (minimum 90 cm in clear view), without a threshold to ensure an easy passage for a person in a wheelchair;
- space providing freedom of movement, including full wheelchair rotation (Fig. 6);
- anti-slip flooring or carpet enabling safe movement even on wet surfaces;
- safe railings also allowing to look outside in a sitting position (Fig. 9);
- canopies or awnings protecting against rain and excessive solar radiation;
- walls protecting against wind and ensuring privacy;
- plug-in sockets for connecting, e.g.: TV sets, heaters, grills, etc.;
- arrangement of the potted greenery ensuring that it can be looked after in a sitting position.

5 Conclusions

Private house outdoor spaces are of great utility importance; they both complement and take over some functions of living quarters. What is more, outdoor spaces have an aesthetic significance as they are an important decorative element of the facade and the body of the building. Their ergonomic design requires taking into account such postulates as:

- sun exposure (south, south-west);
- size and proportions enabling the realization of various housing needs and taking over the functions of a living room during warm days and evenings;
- acoustic isolation from the street noise and visual isolation from passers-by and neighbors;

- protection against adverse weather conditions (wind, rain, etc.);
- accessibility for people in wheelchairs.

The best conditions for being outdoors are provided by partially sheltered balconies or loggias, which give a sense of intimacy and protection against the weather or gazes of strangers [1].

Numerous housing needs can be realized outdoors, such as: active rest, recreation and preventive care. A balcony or loggia often determines the success of a sale or rental of an apartment. This applies in particular to older buildings that are currently being modernized and did not have such space before. However, including external zones in flats increases the costs of development, and such additional expenses oftentimes hinder the purchase of an apartment with a certain number of rooms and suitable space, especially by buyers with a limited budget. Therefore, the design of balconies and loggias requires great care to ensure optimal conditions for the fulfillment of diverse housing needs (including those of people with disabilities).

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Geodesic Domes in Built Environments

Waldemar Bober(✉)

Wroclaw University of Science and Technology, Wroclaw Wyspianskiego 27, 50 370 Wroclaw, Poland
Waldemar.Bober@pwr.edu.pl

Abstract. Fuller's idea of structural systems was based on a separate philosophy, distant from the materialistic and positivist thinking of today's university world. His key concept was the syntropy, hardly noticeable merging force, opposing the diffusing entropy. To see it, one have to cross the boundaries between different scientific disciplines, including physics and biology. Future tensegrity solutions may be borrowed from the organic world and may use materials not known to us yet. One can also see a new application of solutions already known today: designers will understand, that, for example, pneumatics are dynamic high-frequency tensegrity geodesic configurations. We still have not drawn practical conclusions from Fuller's considerations on ecology: "All the categories of creatures act individually as special-case and may be linearly analyzed; retrospectively, it is discoverable that inadvertently they are all interaffecting one another synergetically as a spherical, interprecessionally regenerative, tensegrity spherical integrity. Geodesic spheres demonstrate the compressionally discontinuous—tensionally continuous integrity. Ecology is tensegrity geodesic spherical programming" [1].

Keywords: Geodesic domes · Synergetics · Systems engineering

1 Introduction

The buildings designed by Fuller are striking by their lightness, the tendency to occupy the smallest possible area, as well as the ease of both assembly and disassembly (at some time, delivering the entire building by airship). As commentators note, "The building is becoming a strategic act of colonizing Earth, claiming land, which was very much like the American tradition of creating places. But there was one significant difference from the previous story. Fuller did not combine land ownership with the mythical reservation of land and soil, claims that have always resulted in discord, wars and destruction. For Fuller, ownership meant living in one place for a certain period of time, using the land, whether as an area serving as a source of food, or as a home. It also means that the earth is still accessible to others, just as the sea is still accessible to others, as soon as the ship exceeds a given fragment of it. "For Fuller, an absolute understanding of property rights is contrary to the laws of the universe. He believed that on a constantly shifting sea, no one who crosses it aspires to "own" water under the hull of his ship" [2].

The domes have become the best-known fruits of Fuller's design and architectural studies. As Amy Edmondson notes, "Triangulated coating with 20-wall symmetry

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provides the most effective method of surrounding space with a minimum of material and effort. Accordingly, nature relies on this elegant design in many situations requiring protective housings, regardless of scale. Examples include small sea creatures called actinomycetes, a fibrous corneal network of the eye, as well as protein coatings for many viruses" [3]. And a little further: "Around the mid-twentieth century, it became clear that the design of the Universe uses separate compression and continuous stretching, but until then Man was guided by the erroneous, superficial thinking that there may be lumps and continuous compression (…). It is only the human mentality that has wrongly tried to organize the idea of construction. The essence of Fuller's message is that humanity must learn the principles of nature. We must abandon our concept of construction based on a building block in favor of comprehensive solutions that use the inherent features of stretching and compression. The latter tends to perform local, independent construction tasks in nature, while the first specializes in connecting systems over long distances. Although we are already aware that the universe is not built like a pile of bricks, but still this awareness has not affected our approach to construction. Leaning on a building block has remained roughly unchanged for thousands of years, with efforts to resist the watchful force of gravity by the weight of the structure. Instead, says Fuller, we must think in terms of entire systems in balance, in terms of all-directional forces interacting in self-stabilizing patterns. If, by imitating nature, structural design seizes the opportunity to benefit from the integrity of stretching, these whole systems will prove to be much more durable than could be predicted from the analysis of their individual parts" [3].

2 Synergistic Geometry

Fuller gave his geometrical studies the name synergistic geometry or synergistics. It is distinguished by the courage or unceremoniousness with which Bucky moved his conclusions across the borders of individual fields. This resulted in statements such as "two lines cannot go through the same point at the same time." In the introduction to the book Critical Path Bucky came from the fact that in atomic bonds the terms "positive" and "negative" cannot be understood as "good" and "bad", because both are good for the universe, and he derived directly from this: "There are no good or bad people." In the modern university world, such a leap from field to field is absolutely unacceptable. For Fuller, it was everyday life. The same happened in his synergetic geometry. When analyzing individual Platonic solids (tetrahedron, cube, octahedron, dodecahedron and icosahedron) he noticed that the icosahedron has different properties associated with different electron properties among elementary particles, so "the function of an icosahedron in the universe may be to press the cosmic energy switch to direct it to local maneuvering cycle" (Fig. 1).

Fuller noted that the above-mentioned Platonic solids are one family, and when you build an icosahedron model with rigid edges but flexible nodes, it can be smoothly transformed through individual forms to the tetrahedron. In his lectures, he often entertained listeners with a demonstration of these transformations, which he called the "jitterbug" transformation, from the name of fashionable dance at that time. This served as an illustration of the truth that perfect static balance is impossible, and we are

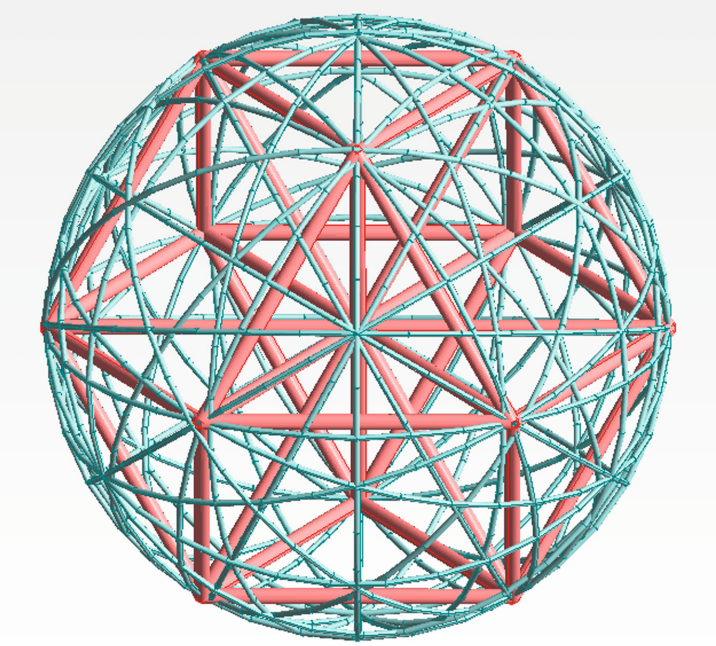

Fig. 1. Bar solids of Fuller's geometry based on the VE vector

surrounded by dynamic, ever-changing events of the universe. However, beyond this volatility, permanent, mandatory laws can be seen. Fuller discovered them, among others, during his geometrical experiments. For example, if you enter an icosahedron into the rhombic dodecahedron, its vertices divide the long diagonals of each rhombus into two unequal sections, the longer of which is 1.618 shorter [3]. The proportion appearing here, often visible also with other geometrical transformations, is the famous golden division known in architecture. It became obvious to Bucky that a man-made decimal system is unnatural since it requires the use of unnatural irrational numbers. So he was looking for something more natural - and this turned out to be for him the above-mentioned set of alternately arranged octahedrons and tetrahedrons. In this lattice system there is a 60° angle between individual bars, which gives the most advantageous strength and economy, incomparably better than a Cartesian system based on a 90° angle. Bucky was convinced that the energy phenomena of nature run along lines inclined to each other at an angle of 60° and even in a vacuum, nature keeps this system ready for immediate use at any opportunity.

3 Geodesic Dome

The geodesic dome is an extremely durable roof covering with the lowest own weight in relation to the volume of the enclosed space. The name, invented by Fuller, results from the existence of geodesic lines on the outer surface of the dome, i.e. sections of large circles; these lines are always the shortest connections on the surface of the sphere between any two points on this surface. Thirty years ago, Walter Bauersfeld, looking for a structure for the thin shell of the Zeiss Planetarium dome in Jena, came up with the idea of using a circular truss. However, Fuller was the first to refine and popularize the full "grammar" of geodetic constructions. The constructive problem is to create such a support structure on the basis of a geodetic mesh, so that the room covered with it is suitable for industrial production, that it is possible to quickly and easily assemble using the minimum of materials with the lightest possible weight, so that it does not require support, to be profitable, to make to be dismantled and reused, to be suitable for transport, to be suitable for extreme climatic conditions, etc. (Fig. 2).

Fig. 2. US pavilion for the exhibition Expo 67, Montreal (photo by author)

The dome from Expo 67 was not just a conglomerate of steel bars and glass panels. As Fuller himself wrote: Looking at the geodesic dome in Montreal, he sees a very beautiful piece of mechanics. That's not all, and you'll see more thanks to your

intuition. See the partitions that can work on the principle of photosynthesis and so on, they can let in and out of light. It is possible, like our own human skin, where all pores and cells are organized so that some of them are sensitive to light, others to sound, and some of them are sensitive to heat, and it would be perfectly possible to create a geodesic dome about very small fields, where each of them can be a polygon of the same size. Some can be a screen, others breathe air, others let in light, and the whole can function just as well as human skin. And I really think that such geodesic domes will be constructed" [2]. At one stage, Fuller imagined a network of domes erected on all continents, serving as great containers of knowledge, while constantly updating his resources with telecommunications connections. This idea, as an inspiration, later contributed to the creation of a global IT network (Fig. 3).

Fig. 3. Central Manhattan geodesic dome [2]

Even more far-reaching action was Fuller's proposed city covering with domes, which was to give extraordinary economic benefits; the most famous was his proposal to erect a two-mile diameter dome, which was conceived to cover central Manhattan, covering west-east area from 42 street on Hudson River to East River, and south-north area from 22 Street to 62 Street. Under the dome, Fuller imagined liquidating car traffic and replacing it with public transport; perhaps this proposal was more utopian than the dome itself. However, Fuller's very important argument was to reduce the surface that causes heat loss. "Bucky has calculated that the total area of the dome's shell will be less than 5% of the total area of the walls and roofs of the buildings it covers, which gives a huge thermal advantage" [4]. He therefore claimed that "the savings achieved in ten years will cover the costs of building the entire dome. Covering cities with domes will be necessary for the development of the Arctic and Antarctic" [2].

4 Aesthetics and Design

Fuller's aesthetics and design differ significantly from both modernist architecture and earlier construction. As he claimed, it was his own conscious choice, largely the result of his experience with the sea (which can be seen in the use of mast structures). Fuller wrote: "Many people asked if Bauhaus ideas and techniques had a formative effect on my work. I must answer emphatically that I do not" [7]. It is interesting that he combined his marine and engineering preparation with shaping design sensitivity. "This intuitively expressed aesthetic perspicacity - sensually tunable by man - involves acquiring specific skill to process these boundary nuances of the dimensional proportions of cooperating component functions of the subsystems of the designed system" [7] (Fig. 4).

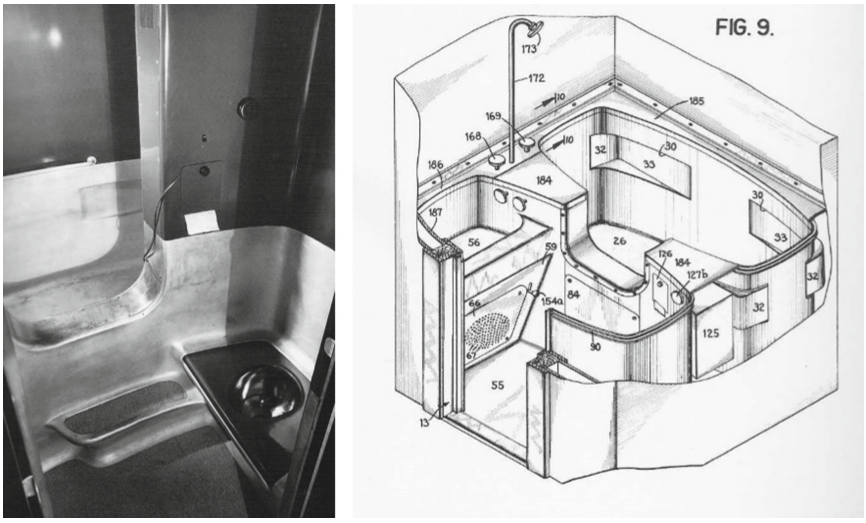

Fig. 4. Dymaxion bathroom [2]

In 1938, Fuller designed the Dymaxion bathroom, carefully studied to the smallest dimensions, but ensuring full comfort of use for one person. In Fuller's idea, such bathrooms, factory-made, could be installed in flats without an adequate sanitary standard (in fact, American homes often lacked them at that time); if necessary, bathrooms, like any other household appliances, could also be moved. One bathroom weighed about 250 lb; had many specially designed facilities and technical solutions to ensure economical operation, including water consumption savings, special ventilation system, integrated lighting, etc. Fuller's ecological approach was expressed in the search for efficient and ergonomic solutions, which in the case of mass production would have low costs. He was also focused on seeking solutions that change people's habits and thus do a favor to the people themselves, because modern technical solutions can make their lives more simple and pro-ecological. As he wrote: "I've never felt that

the design (bathroom unit) was really worth realizing because there are other better ways to clean yourself. Today we learn from technologists that when cleaning a watch or a gyroscope, it is not immersed in a bath tub. It turns out possible to cope without plumbing, using sprayed water under air pressure. In this way, we can do a very successful personal cleaning task with just a liter of water delivered to our place of residence" [2]. Fuller was a strong supporter of the view that "less is more", and rather not in the aesthetic sense of the expression, as Mies van der Rohe did. Fuller imagined that the buildings would ultimately be "degenerated" to such an extent that it would be possible to do without building materials, and builders would instead rely on "the electric field and other completely invisible environmental controls" [5].

5 Conclusions

The Should all these solutions, as utopian, be classified as worthless fun? One of the authors writing about Fuller, Scott Eastham, responds in this way: "Whether buildable or not, desirable or not, these constructions have one important common feature. They seem to encourage people to live easier on Earth, and even for some time to carry out the masses of their building material, as if to allow the planet's eccentric ecosystems to regenerate. This is how Fuller's words can be read: a person may be able to focus and deploy on the ground without depleting it" [6]. As he continues, "It would be quite easy to treat Fuller as a prophet of technological development (…). However, no technology is neutral. Any new technology is innumerable ways shaped by the culture in which it was developed, able to drastically modify all variables as a result of a delicate balance between nature and culture. Fuller knew this, and actually designed his inventions with the specific goal of bringing about far-reaching cultural changes" [6]. Subsequent implementations of geodetic domes confirm the above opinions and are an announcement of the constant presence of this type of structure in the image of the built environment.

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Micro-units and Co-living Spaces in Post-industrial Surroundings. The Human Dimension in Adaptive Reuse Projects of Historic Buildings Converted into New-Generation Student Residence in European Cities

Krystyna Kirschke, Paweł Kirschke, and Elżbieta Komarzyńska-Świeściak(✉)

Faculty of Architecture, Wroclaw University of Science and Technology, Wroclaw, Poland
elzbieta.komarzynska-swiesciak@pwr.edu.pl

Abstract. As the increasing demand for sustainable investments together with the changing environmental and economic conditions are currently observed, adaptation and conversion of historic buildings gains on popularity. This has simultaneously led to the creation of a new area on the housing market that is often referred to as co-living. It is about apartments or houses with shared spaces and amenities. These two trends are reflected in adaptive reuse projects of historic industrial buildings converted into co-living spaces with extremely varied target uses. This paper analyses design strategies for managing the historical character of post-industrial buildings in converting them into new-generation student residences as exemplified with a series of investments in European cities. We presented many challenges relating to micro-units and co-living spaces design in historic buildings along with corresponding solutions. We also set some methodological directions and certain guidelines and principles for research in this field. In conclusion, we discuss certain disadvantages and limitations of these kinds of investments.

Keywords: Adaptive reuse · Co-living · Heritage building preservation · Human dimension · Human factors · Student residence · Student Hotel

1 Introduction

For several decades, business models involving the adaptation of historic post-industrial buildings for service purposes have been quite commonly used in European countries [1–6]. This resulted in the creation of office complexes (e.g. *The Factory* Berlin, *Technology Park* Berlin *Humboldthain*, *Les Magasins Généraux* building in Paris, *Monopolis* in Łódź, *COOP* in Brussels), boutique hotels and hostels (e.g. *Vienna House Andel's* and *Focus* in Łódź, Hostel Fabryka in Warsaw), and multifunctional service and residential centres (e.g. *Kanaal* in Antwerp, *Le Conterie* on the Murano Island in Italy,

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Gasometer in Vienna, Loft Zawisza in Gliwice, *De Girarda* lofts in Żyrardów, Browar Lubicz in Kraków and Browary Wrocławskie). The flats located in them vary in terms of standard and surface area ranging between about 25 to 40 m^2. For a dozen or so years, in academic cities student residences keep emerging also in abandoned post-industrial buildings. These complexes offer a wide range of services, co-working spaces and micro-apartments with surface areas from about 12 to 23 m^2. The target user group includes students, especially foreign scholarship holders, and Y and Z generation people who have already completed their studies, started their carriers, but still highly appreciate community living and the so-called sharing economy [7–9]. None of these people actually treat this form of residence as their target; they usually rent premises for up to 12 months, sometimes longer (for the duration of student exchange, study, or corporate contract). They are also ready to limit both their assets and private living space (minimalism trend) in favour of maximizing the common, social space. "Global nomads" interested in short-term rental are another group of users [9].

Due to the availability of human resources and facilitated distribution of finished products, until the mid-20th century, some types of factories: bakeries (Fig. 1), printing houses (Fig. 2), breweries, power plants and light industry plants were located in the city centres or on their outskirts [3–5]. Many years later, due to significant urban sprawl, these locations have become extremely attractive, offering tenants of revitalized facilities quick access to the bustling city centre or to university campuses. The growing popularity of using post-industrial facilities for residential purposes is also supported by the quality of their architecture, comparable to that of civic buildings [3, 10–12]. Examples include Izrael Poznanski's Factory in Łódź, now the Manufaktura shopping mall, *AEG Turbine Factory* in Berlin, or the Mamut bakery in Wroclaw [12] being converted into a student dorm (Fig. 1). It even occurred that industrial buildings were treated as a "show of force" of the city authorities, as was the case with *Bankside Power Station* in London, successfully rebuilt into the *Tate Modern* [13]. An additional factor that makes it easier for investors to succeed in business is that former factory facilities are relatively cheap. This is due to the fact that historic buildings, for technical and environmental reasons, can no longer fulfil their original function, and at the same time, as architectural historic sites, they suffer from many adaptation restrictions imposed by local building restorer's offices [11, 12, 14].

Fig. 1. (left) *Basecamp* dormitory complex (designed by Grupa 5 Architekci) - adaptive-reuse and extension of Mamut bakery in Wroclaw planned to be realised in 2020 (PL). On the left: ceramic-cladded flour storage building adapted for main entrance zone and dormitories, on the right: new wing of the *Basecamp* dormitory (visualisation by Grupa 5 Architekci [15]).

Fig. 2. (right) *Basecamp* dormitory complex (designed by Grupa 5 Architekci) realised in Łódź in 2017 – adaptive-reuse of Dziełowa Printing House (PL) (photo by Grupa 5 Architekci [16]).

2 Up-to-Date Research and Methodology

Our research analysed the functional and spatial arrangements in dormitories built in the late twentieth and early twenty-first century in adapted post-industrial buildings of European cities, where the focus was to adapt the facility to the needs of human, individual users at the same time taking into account selected issues imposed by restorer's offices.

A review of literature has shown that there are papers published in magazines and professional portals on conceptual or implementation projects meeting the above-mentioned criteria. These are all case studies [5, 11, 12, 17]. However, there are no scientific papers synthesizing the knowledge on locating student dorms and micro apartments in post-industrial historical buildings in the European culture [18–21]. On the other hand, the issue of the architectural and urban revitalization of post-industrial areas discussed in numerous articles [14, 17, 21–23] and monographs [1–6, 10], and it was also subject of a series of conferences and competitions (*ProRevita*, *Rewitalizacja*). Similarly, dormitories, micro-apartments and co-living spaces have been discussed in European literature, but these authors focus mainly on newly designed facilities [7–9, 24, 25]. Such investments in adapted post-industrial buildings constitute a relatively new phenomenon, hence there are few papers describing and synthesizing knowledge on the subject [11, 12, 22].

The analyses presented in this article put special emphasis on the process of "humanization of the factory", i.e. the transformation of its initial post-industrial functional layout, into a complex combining groups of micro-apartments and co-living spaces intended for students. These analyses were presented separately for each of the functional zones mentioned above, with attention being paid at the same time to the specific character of their organisation in the re-constructed facility. All the aspects of our analysis have been reflected in the adopted chapter layout. Problems related to restorer's requirements and technical issues universal enough to be discussed in relation to a larger group of facilities have been mentioned in places where this was directly

related to the functional and spatial layout of the buildings in question. Our basic research method included case studies (*in situ* analysis, process and design documentation studies) and our participation in numerous projects involving revitalization of historic buildings for service purposes developed in *research by design* framework [11, 12, 15, 16].

3 Adaptation to Micro-apartments

The idea of providing minimum living space in combination with a wide range of offered common space inspired architects fascinated by the idea of the welfare state already in the interwar period [8, 26, 27]. It was in this period that the *Isokon* and *Kensel House* buildings in London were completed followed by such facilities as a hotel house containing miniature *maisonnette* flats at the WUWA housing estate in Wrocław (Breslau until 1945), and the study entitled Die Wohnung für das Existenzminimum [Flat for the minimum of existence] was conducted for the city of Frankfurt [26]. In modern, commercial complexes of microflats, the extreme limitation of their surface area results from the ideological assumptions described above, but also from the desire to ensure maximum profitability of the investment [9]. Such a unit, intended mostly for one or two people, is divided into three functional areas: mini-hall, bathroom and open space housing two contrasting functions: living room (sometimes with a kitchenette) and bedroom (Fig. 3A–D).

Multi-storey residential wings of co-living complexes are usually located in former warehouses (Mamut bakery [12, 15]) or offices (printing house in Łódź [16, 17, 30]). Their functional layout consists of two (Fig. 3B) or three (Fig. 3A, C, D) longitudinal bays, but the latter, three-bay solution (with the middle bay being the traffic space) being more suited to the new function. In buildings of this type, two residential units (with surface areas ranging from approx. 12 to approx. 23 m^2 each) usually fit between the main structural axes, whereas in the case of post-industrial buildings the average span is approx. 5.5–6 m. Each of them is 2.5–2.8 m wide, which allows for a functional arrangement similar to a hotel room (Fig. 3A–D). In the microscopic entrance area, in addition to a wardrobe or hangers, entrance to a compact bathroom with shower can also be found (width approx. 1.1–1.8 m, area approx. 2.5–3 m^2). The so-called residential area (an area with a full width of the module intended for bedroom), the depth of the interior and supply of daylight derive from the depth of the external traffic routes of the adapted building and are on average 6–9 m. The lighting in such a room also depends on the size and location of windows, which is closely related to the façade module of the historic building, which is usually subject to restorer's protection [12]. In contrast to new investments, almost each of the units in the adapted building differs slightly in terms of surface area and interior layout. Thus, it becomes less realistic and less economically viable to implement fully standardized, multifunctional furniture there.

Walls units are used for the kitchen, bathroom, bedroom and lockers along with free-standing and mobile furniture items (Fig. 4). In the case of narrow traffic routes, the relatively large height of post-industrial interiors (approx. 3.5–4.5 m net) provides

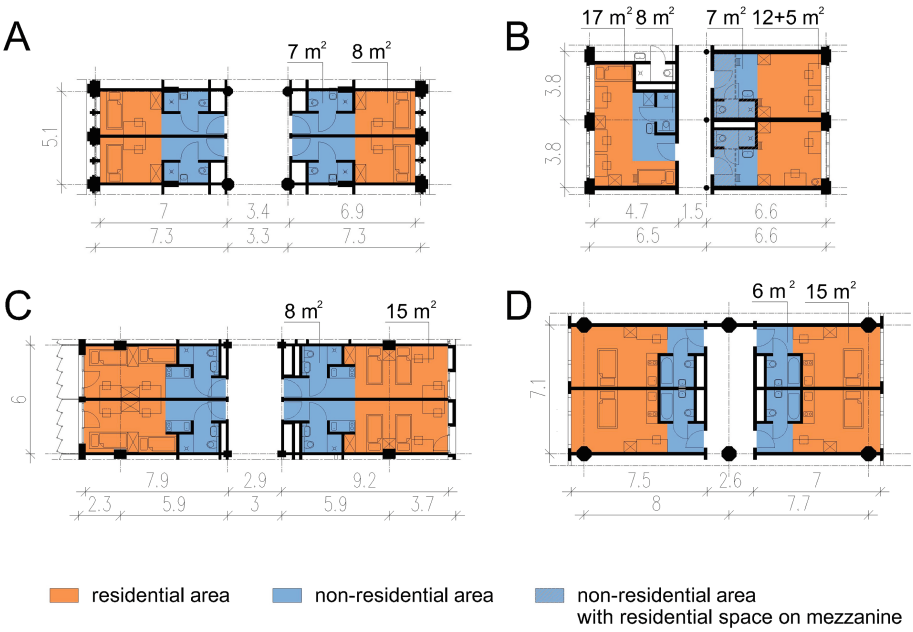

Fig. 3. Residential units' plans of: A. *Basecamp* dormitory (designed by Grupa 5) - adaptive-reuse of Mamut bakery in Wroclaw (PL) (by E. Komarzyńska-Świeściak based on [14]). B. *G27 CIEE Global Institute* dormitory (designed by Macro Sea) - adaptive-reuse of Emil Gursch typefoundry's factory in Berlin (by E. Komarzyńska-Świeściak based on [28]). C. *Basecamp* dormitory (designed by Grupa 5 Architekci) – adaptive-reuse of Dziełowa Printing House in Łódź (PL) (by E. Komarzyńska-Świeściak based on [15]). D. The Student Hotel Amsterdam City (designed by Penta Architecten BV BNA) - adaptive-reuse of printing house and office buildings of *Parool* and *Trouw newspapers* in Amsterdam (by E. Komarzyńska-Świeściak based on [29]).

an opportunity for enlarging the residential space by constructing of a mezzanine with a bed (*Basecamp* dormitory in the former Dziełowa Printing House in Łódź, Fig. 3B, Fig. 5 [16, 17, 30]), by comfortable use of bunk beds (*G27 CIEE Global Institute* dormitory in Berlin [28, 31–34]). Usually, in the residential wings, there are also spaces dedicated to building closer relationships between residents of a given floor or group of rooms (e.g. common living room, kitchen and small niches in the corridors). They are implemented within a single traffic route and structural module, between the residential units or in places impossible to transform into rooms (e.g. in corners of a building). Depending on the standard of the investment, there is one such a zone for a couple or a dozen rooms (e.g. 35 rooms in the Macro Sea investment [28], 8–11 rooms in the Student Hotel project [29], 25 rooms in *Basecamp* in Łódź [16]).

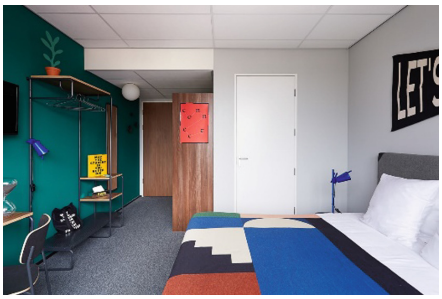

Fig. 4. (left) Interior of residential unit in The Student Hotel Amsterdam City (designed by Penta Architecten BV BNA) - adaptive-reuse of printing house and office buildings of *Parool* and *Trouw newspapers in* Amsterdam (photo by Macro Sea [28]).

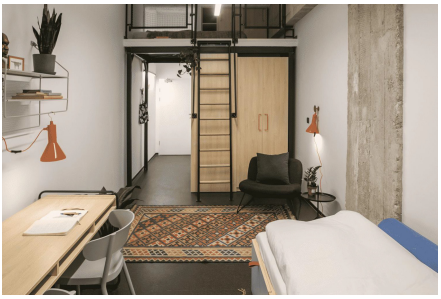

Fig. 5. (right) Interior of residential unit in *Basecamp* dormitory (designed by Grupa 5 Architekci) – adaptive-reuse of Dziełowa Printing House in Łódź (PL) (photo by Grupa 5 Architekci [16]).

4 Adaptation for to Multifunctional Co-living Spaces

Selected projects and their implementations, which use a combination of residential zones with micro-apartments and co-living spaces, have a functional structure closer to that of a hotel or hostel than of a typical dormitory [9, 19, 20], as exemplified by the *Studentenheim Gasometer* in Vienna, which offers rooms in apartments intended for several people [22]. Therefore, adaptation to such a function requires taking into account the specific character of the functional and spatial model resembling that of a hotel [21]. Its very essence consists in the existence of two structural units. The operational one, which consists of four divisions: residential, catering, multifunctional and recreational rooms, and back-up facilities (administrative, social, technical and managerial. In the analysed cases, in the multifunctional and recreational zones, the residents have at their disposal an extensive reception area, a large co-working space, a restaurant and shops on the ground floor (Fig. 6), a laundry room, and often thematic common spaces (e.g. a terrace, cinema room, reading room (Fig. 7), games room, swimming pool, relaxation area). This allows for offering a wide range of additional services, from organized events and community animation to a concierge, laundry and cleaning services.

In the case of adaptation of post-industrial facilities, preservation of factory equipment and infrastructural facilities presents another special issue. These are the so-called movable technical monuments, which stand for the genesis of a given place, e.g. printing presses, conveyor belts or ovens. Depriving the factory of its movable heritage (provided that it has been preserved) deprives it of its significant historical value [23, 34]. Showcasing such elements in interiors dedicated to dorms may be less obvious, however, in appropriately selected places such a procedure allows for giving the

Fig. 6. (left) Interior of a restaurant in *Basecamp* dormitory (designed by Grupa 5 Architekci) – adaptive-reuse of Dziełowa Printing House in Łódź (PL) (photo by Grupa 5 Architekci [16]).

Fig. 7. (right) Co-living space in The Student Hotel Amsterdam City (designed by Penta Architecten BV BNA) - adaptive-reuse of printing house and office buildings of *Parool* and *Trouw* newspapers in Amsterdam (photo by Penta Architecten [29]).

interiors a unique character, referring to their former function. The co-living zones are particularly well-fitted for this purpose, as it was envisaged in the *Basecamp* dormitory design in Wrocław (a fragment of a bread baking oven [12, 15]) and implemented in *The Paper Factory Hotel* in New York (two printing machines [35]).

5 Conclusions

With selected examples, we have illustrated the problems faced by an architect who adapts post-industrial buildings to modern hotel apartments, which are expected to preserve the authenticity of a given historic building while at the same time providing comfort and a sense of community to its users. The analysis of functional and spatial layouts allows us to conclude that specific zones of an industrial building (supply, production, storage and dispatch, as well as office rooms) and appropriate diversification of the spatial and structural layouts used allow for choosing optimal design solutions for adaptation of these facilities to the needs of a new generation of dormitories. What seems the most obvious is to establish service shared spaces in former production halls, and rooms in multi-storey wings that originally housed technology lines or offices. It is crucial to configure new functionalities in such a way as to match them to the historic structure, taking advantage of its advantages and limiting the destruction of the original facility structure, which usually constitutes the most valuable element of a post-industrial historic building [23, 35]. Only then is it possible to preserve its "spirit" of a given building, which makes the adapted facility unique. The discussed investments, although they do not guarantee full repeatability and standardization of design solutions and entail the necessity of incurring adaptation costs, offer attractive locations and a space enriched with eclectic, Art Nouveau or Modernist details, as well as renovated, monumental façades made of concrete or faced with ceramics, sandstone and granite. All in all, the adaptation of post-industrial buildings to

the needs of modern users should be considered as an important form of protection and preservation of architectural monuments. Such a revitalization project will certainly be continued, mainly due to the attractive location of these factories. The fact that the construction of turnkey micro-flats in a standard sufficient to provide basic living conditions at an affordable price [8, 9] requires significantly lower financial outlays on the part of the investor than in the case of a hotel or an A-class office building will certainly provide a significant development impulse as well. Therefore, it should be expected that many post-industrial complexes may be transformed into dormitories combining micro-apartments with co-living and co-working spaces, which is justified by the huge interest of the public and the possibility of achieving high rents.

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Study of Informal Human Settlements in Picoazá Parish, Portoviejo Canton: Towards a Bioclimatic Housing Approach

Juan Briones Macias[1(✉)], Maikel Leyva Vazquez[2], and Jesús Rafael Hechavarría Hernández[1]

[1] Faculty of Architecture and Urbanism, University of Guayaquil, Cdla. Salvador Allende Av. Delta y Av. Kennedy, Guayaquil, Ecuador
{juan.brionesma, jesus.hechavarriah}@ug.edu.ec
[2] Faculty of Commercial Education and Sciences, Bolivariano Technological Institute of Technology, Guayaquil, Ecuador
mleyva@itb.edu.ec

Abstract. Informal human settlements in the Portoviejo Canton - Ecuador, have been a constant problem to be outside the guidelines, regulations and government regulations that preserve the urban planning by improvising their ways of living within an improvised territory of basic services. The objective of this study is to reduce informality by means of an architectural proposal for productive bioclimatic housing, with the aim that the inhabitants obtain a decent and sustainable home in the long term; to use their own ancient construction techniques to reduce housing costs and generate income through urban gardens in the patios of their houses. The descriptive qualitative method using observation and interview with actors will be used to obtain opinions on the adaptation process and participation in the constructive designs of the houses; collecting design strategies that improve living conditions and help preserve the environment.

Keywords: Informal human settlements · Urban informality · Urban settlement architecture · Productive housing

1 Introduction

"Urban informality in the cities of Latin America has become the most widespread way in which low-income inhabitants solve their room needs, which has occupied the third part of the city, despite efforts of local governments for counteracting it, increasing both the supply of low-cost housing and the control to prevent the emergence of new informal settlements" [1].

This study suggests reforming government policies, creating a community-based participatory design and implementing an inclusive design of socio-economic and environmental planning, acting as vehicles for sustainable development [2].

"By simulating the regularization of some well-identified informal settlements, […] it is possible to demonstrate the effectiveness and efficiency of the 'sanatorium' instrument, highlighting its potential both from local finances and the perspective of sustainable planning on a metropolitan scale" [3].

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[1] Borbon, 2018 indicates that urban informality is the opening in the construction of alternative environments in accordance with the existing offer of economic housing where the mix of uses, productive housing, progressive development, among others, will have similar importance together with the generation of these settlements, another type of citizen with a high sense of collectivity is formed.

As previously stated, informal urban settlements grow rampant due to the lack of legalization of these spaces, to overcome this condition it is essential to build a comprehensive and innovative approach to transform what is traditional politics [4].

Considerations to propose a design with the objective of reducing informal human settlements according [5]:

- Generalize the differences that arise within localities with a high presence of informality with other sporadic situations.
- Have knowledge about current informal settlements in central or peripheral areas.
- Know the neighborhoods already consolidated and those that are in early stages.
- Present the presence of flat or inclined topographies.
- Consider the reduced size in some cases or considerable dimensions in others.
- The vocation of the neighborhoods: be it purely residential or with mixed uses.
- Take into account the different levels of social and urban consolidation of the settlements.

It is necessary to analyze the phenomenon from urban planning, which is affected by overcrowded populations that are caused by various factors that include administrative bureaucracy, counterproductive coordination of organizations, inadequate infrastructure development, economic challenges, governance and the problems of equality, equity and race; inducing as consequences the poor quality of life, exclusion and marginalization due to social differences, construction of empirical houses, social discrimination.

Therefore, the study will analyze the conditions of the Picoaza Urban Parish in the Portoviejo Canton, Manabí province, Ecuador.

Among the objectives we have:

- Prepare an architectural proposal for bioclimatic housing in informal human settlements in Picoaza Parish, Portoviejo.
- Design a typology of bioclimatic housing that develops the ancestral construction techniques of the Picoazá Parish.
- Integrate the design of the house with green infrastructures.
- Propose a productive house which improves the quality of life of the Picoazá Parish, through the use of urban gardens.

2 Methodology

The following article evaluates the professional perspective of urban informality and infrastructure planning to develop a strategy for sustainable urban development and improve the challenges of urban informal settlements by studying analogous models of success at the South American level taking in particular a territory with conditions similar to the study area.

Continuing with the methodological process, constructive parameters to be used from the model are described and as a purpose the design is cohesive to a type of productive housing model with bioclimatic elements.

The study adopts a case study methodology with the qualitative method of data collection and the mixed method of data analysis through a survey of recognition, participant observation and the interview with environmental professionals. The data was analyzed using tables, images, percentages and the informed statements of the interviewer [6].

3 Results

3.1 Comparative Study: Favela Rocinha, Rio de Janeiro and Picoazá, Portoviejo

The houses in the Picoazá Parish reveal a design of single-family houses adapted with bioclimatic principles to tropical climates, which goes back to their ancestors [7], which nevertheless this tradition and constructive technique has been disappearing.

The architectural design of each housing unit in the Favela Rocinha, Rio de Janeiro, Brazil has 2 bedrooms that cover accessibility measures and bioclimatic strategies for energy efficiency, since they have a double height [8].

To improve energy efficiency and thermal comfort in homes, it is essential to harmonize the construction with its climatic conditions. This is especially true for tropical areas such as Manabí with subtropical dry to tropical humid and extremely humid tropical characteristics [9], where a large part of the low-income housing for both Brazil in the Rocinha Favela and Manabí with the Picoaza Parish, and sun and wind opportunities are often abundant. If design strategies that respond to the climate are not incorporated, poorly ventilated and overheated homes will be generated and, consequently, social problems [10]. Therefore, an appropriate balance between ventilation, heating/cooling strategies and solar radiation in the envelope is necessary to promote well-being, as well as a reduction in energy consumption.

3.2 Construction Parameters

The wrap in bioclimatic homes is an indispensable factor, so it incorporates an innovative approach: which in ancient times used mud on the facade to reduce the temperature [11].

The integration of green infrastructures at all levels proposes effective bioclimatic improvements [12] for housing, proposing urban gardens within the house to improve air quality and grant good shade to homes with the use of Albizia julibrissin (Acacia of Constantinople) [13].

Therefore, a fundamental parameter in the analysis will be the resilience of the home against external factors and how to dissolve them using nature and its properties. The ancestral construction technique of “enquinche”, originally from Manabí, Portoviejo was introduced in this study as an indigenous ancestral technique of the study area.

3.3 Productive Housing

The concept of productive housing is little known, since it develops more in rural areas by having most of the primary production [14], so the introduction of an urban garden in A parish with limited resources such as Picoazá will boost its economy and seek to improve the quality of life of its inhabitants.

The design of this house will contemplate an urban garden using the concept of green infrastructure (IV), urban green spaces in the form of private and public green areas combined with planned and unplanned vegetation, which will function as a key element in the sustainable solution for the community of Picoazá. For green infrastructure models, it provides ecological, social, cultural, technical and economic functions that also include low-density housing and private gardens [15].

3.4 Analysis: Users and Professionals

The survey was structured in such a way that it can give answers to both professionals and the inhabitants of the Picoazá Parish. A sample with 200 representatives of the parish was prepared and 5 professionals were chosen, from the environmental, socioeconomic, bioclimatic, architectural and civil engineering branch to jointly determine appropriate results for the conditions of the informal human settlement (Tables 1 and 2).

Table 1. Options and criteria of users/ratings

Objectives	Indicators	Index	Techniques
Design a typology of bioclimatic housing that develops the ancestral construction techniques of the Picoazá Parish	Typology of ancestral homes	Type homes and their techniques	Data collection through web visits Interviews on the site
Integrate housing design with green infrastructure	Bioclimatic building systems	Environmentally friendly building materials	Observation in situ Collection of data on the web
Propose a productive home which improves the quality of life of the Picoazá Parish, through the use of urban gardens	Productive housing	Help economic development	Documentary compilation Interviews on the site

Table 2. Options and criteria of users/ratings

Weight	0.1	0.4	0.4	0.1
	Cost	Social benefit	Environmental benefit	Economic benefit
A regular house	2	1	1	3
A bioclimatic house	5	5	5	4
Ancestral construction	3	4	5	3
A productive house	4	3	5	5

3.5 Bioclimatic Housing Proposal

The design proposal applies a hybrid model which combines urban/rural activities, a functional and demonstrative proposal was conceived, based on bioclimatic design strategies and use of natural resources, articulating the proposal through a common interface or link between the territory and urban development (Fig. 1).

Fig. 1. Bioclimatic productive housing design proposal

The proposal shares a direct relationship with nature, by taking advantage of its environment through the production of its land with urban gardens, use of native materials from the area such as guadúa cane, wood, cade (tagua palm leaf), mud, clay, manure and straw. The ancestral construction technique of "enquinche", originally from Manabí, Portoviejo was used, which consists of assembling the skeleton of the house with guadúa cane and wood, then the gluing is made that is a mixture between mud, clay, manure and straw; elaborating a uniform consistency similar to the traditional concrete mortar, the mixture is allowed to dry for 10 to 15 days and is finished off with a cade roof. Through this constructive technique and production within the home, users can reduce costs, improve their lifestyle and contribute to the environment.

4 Conclusions

Through this constructive technique and production within the home, users can reduce costs, improve their lifestyle and contribute to the environment. As a final conclusion we have that an informal human settlement can become an organized urban cluster of houses that propose a better definition of it, being a formal human settlement that meets the needs of the inhabitants of the Picoazá Parish.

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The Karkonosze Network of Swimming Pools - A Consensus of Tradition and Modernity

Anna Wojtas-Harań(✉)

Faculty of Architecture, Technical University of Wrocław, Wrocław, Poland
anna.wojtas-haran@pwr.wroc.pl

Abstract. At the turn of the 20th and 19th century, bathing areas were built in almost every resorts of the mountain and the foothill areas of the Jeleniogórska V-alley and the Karkonosze (the Giant Mountains). Was the architecture of swimming pools dominated by regional ideologies that have extended the phase of romance, so rooted in the region, despite the fashion for modernism? Was it really the result of a specific regional variety of modernism in which nature, landscape and surroundings played a major role? The local bathing model, in the spirit of romantic modernism, was also adopted for example in Switzerland. There, functional architecture, erected at the time in an unstable period, incorporated into sentimental landscape systems, personified not only the balance in the spatial sense but also in the spiritual one. The bathing areas of the Karkonosze were not only created in atmospheric locations, shaped by nature, but also in a special relations to the existing regional architecture. The aim of the work is to present the advantages of swimming pools of Switzerland and the Karkonosze, which drew their charm from balance between progressive views and the need of tradition and nature. A method of case analysis was adopted, allowing the selection of characteristic design solutions and principles that make up sustainable architecture.

Keywords: Urbanization · Sports facilities · Mountain settlement

1 Fashion for Modernism and Regional Ideology and Romantic Roots

In the developing Europe at the turn of the 19th and 20th centuries, the need for rest in close proximity to nature became more important. Popularization of therapeutic practices, physical education, travelling, forced the proper role and form of sports and tourist facilities. Recreation centers have become a cultural meeting, where the tastes of historical eclecticism and pictoresque regionalism sometimes crossed, as well as extreme functionalism. The stylistic mix was connected by an aesthetic inscription of the whole into nature. Palaces, recreational places and park foundations from the turn of the 18th and 19th centuries gave the timeless tourist value of the Jeleniogórska Valley and the Karkonosze Mountains [1]. They created a harmonious combination of late baroque, classicist, neo-gothic architecture with natural composition. The design philosophy resulted from the romantic cult of nature, the idea of living in harmony with nature and being a part of it. The energy of romanticism has permanently entered the

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culture of the region. Over time, the whole Jeleniogórska Valley and the Karkonosze gained the features of a landscape park [2].

The modernist movement changed the concept of architecture. Modernism introduced an alternative to artificial eclecticism, decorativism and historicism. The connection of greenery with architecture in the avant-garde trend resulted "from the myth of returning to the sources, in the bosom of nature" [3, p.168], "to the sources of life as s guarantee of the renewal of culture and architecture" [4, p.11]. Buildings designed in the spirit of functionalism were dismembered in order to permeate with greenery. Greenery was being introduced onto the terraces. However Jugendstil was full of floral motifs. Simplified historicism was combined with a garden art.

In many European countries, the homeland protection movement ("oscilating between romantic nationalism, anti-modernism, artistic trends of renewal" [5, p.37]) has gained recognition. The architects of the reform movement designed in a native style expressing the ideal of movement – a symbiosis of landscape, nation and culture [6]. "Instaed of copying old styles, the reformers proposed combining artistic innovation with tradition" [5, p.68], a creative interpretation of traditional folk motifs, cutting off from the 19th-century Swiss style, with care for preserving the natural landscape.

The goal of the revolutionary twentieth century current, in both orthodox and traditional settings, was to provide access to greenery, air, sun and hygiene in urban and architectural solutions. The natural environment played an important utilitarian and compositional element in recreational, tourist and sport solutions. The issue worth discussing is the specificity of the solutions incorporated into the mountain environment. The focus was on bathing areas in the Karkonosze Mountains comparing them to the Swiss bathing areas due to the similarity of genesis and location, among others.

2 Swiss Bathing Areas in the Spirit of Romantic Modernism

Purism in modernism, geometric simplifications moving out to the fore [4, p.10], resulted from the belief in the relationship between social conservatism and tradition and historicism. "Supporters of functional architecture emphasized above all the natural needs of man: food, sleeping, hygiene, water and sunbathing" [3, p.166]. They exhibited function. Like the renaissance thinkers, they thought that emancipation of the body is a step stone on the path to liberating the spirit. Although modernists considered themselves humanists, they were criticized for "underestimating spiritual values and emphasizing the bodily nature of man promoting cult of the body" [3, p.165]. Underestimating the value of the spirit, rejecting traditional patterns, insincerity of ideas, orthodox concern for function were also criticized by proponents of the modernist movement. They used to notice, contrary to the demands of the modernist movement (Neues Bauen), separation from ordinary life. It was believed that the new movement would survive only if it kept on evolving. They were calling for modernism in which people need tradition, sentimental attachment and cosiness, which also have their own meaning [7, p.53].

As noted by Johannes Stoffler, author of the study "Modernism for people: Swimming pool landscape in Switzerland" - modified modernism developed in

Switzerland, which genuinely took into account the basic needs of people. This is evident in the architecture of bathing areas. Landscape has become an element binding the precursor and conservative ideas.

In Switzerland, one of the first artificial pools in Europe was created during the rapid development of industry, the emergence of new techniques at the dawn of the 19th century. The first swimming pool was built in 1822 in Howil near Bern. In the same year, a swimming pool on the Aare river was built in the center of Bern next to the Federal Parliament.

The first public bathing areas took form of the *Kastenbad* anchored on the river, on the lake (e.g. Les Bainsdes Paquis on Lake Geneva 1872, Seebad Utoquai in Zürich 1890, Seebad in Luzern opened in 1885, Seebadeanstalt Rorschach on Lake Bodensee 1923/4) protected from high outside dressing room walls. Hygiene and refreshment was their predominant function.

Modernist swimming pools, which were the result of a new body culture and rest widespread around 1930, celebrated the open landscape, clean water, freedom, vast areas, space for sports and games. The solutions of modernist complexes due to their schematism, geometry, monumentality did not always meet the expectations of customers (e.g. Gartenbad Eglisee in Basel opened in 1931) who preferred bathing in natural conditions.

Reflection on the implementation achievements of swimming pool facilities prompted the development of the concept of swimming pools [7, p.58], which in addition to hygiene and sport, also offered leisure and contemplation of the landscape. The informal prototype, loosely arranged, with reference to the existing topography and incorporation into the landscape, with the naturally shaped garden part was Freibad Allenmoos from 1939. A characteristic feature of the conception were unconventional shapes of pool troughs, framed by picturesque greenery. Greenery served in places as a utilitarian, and aesthetic function, integrating with the landscape. The author of the garden part, Gustav Amman admitted to being inspired by English garden art. He was under the influence of the homeland protection movement. Werner Max Moser, the architect, characterized common achievement with Max Ernest Haefeli and Amman as "romantic". Young architects, CIAM members, did not notice the contradiction in the coexistence of conservative solutions with the new design.

While the above bathing resorts were in a sense a substitute for a countryside in the city - in smaller towns they were perceived as a symbol of status, progress and modernity. As mountain pools, beach pools (bathing areas such as Bödelibad in Interlaken from 1930, or Strandbad Lido/Biel, Lido Luzern from 1929, Schwimm und Sonnenbad in Teufen from 1933), located in an often complicated location, integrated the architecture with the frugal décor of representative greenery. Here as well, the minimalist language of architecture finds its fulfillment in the cameral cubature and the sentimental setting of greenery.

3 The Karkonosze Bathing Areas in Relation to Regional Architecture

The history of bathing places in Silesia was similar to the Swiss ones. The first projects were made in the form of the *Kastenbad* to develop into the form of spatial layouts.

In Wrocław, the capital of the region, which was influencing on the province, the city's most important initiative related to the unloading, increasing growth and population density since the beginning of the 20th century was the expansion of green areas for recreation and sport. Zalesie Sport Park (now the Olympic Stadium) was implemented in the years 1925–39. The arrangement was picturesquely incorporated into the landscape of Szczytnicki Park, a residential estate, riverside areas, permeating alleys, lawns, tree groups.

Almost all of the Olympic disciplines of that time were practiced here including swimming. In the first stage of construction, a swimming pool complex was commissioned in 1927, near the Odra flood canal, regatta route and marina. Raw blocks clinker brick, enriched with a bright detail of reinforced concrete, bore the features of a modernism trend – Neues Bauen. Monumentality, abstractionism, typical for Kozanów Forest Bath (1929) contrasting colors and cubist forms characteristic of Westend Bath (1927) or Różanka Bath (1926) also pointed to the avant-garde language of modernism. However it is difficult to find innovation in a modest architectural form, wooden structures of other Wrocław basins, such as: outdoor swimming pool in Oporów or Morskie Oko. On the other hand, all objects, with the predominance of horizontal lines, eaves, arcades, cornices blended perfectly into the flat riverside area.

In Jelenia Góra, the largest city at the foot of the Karkonosze Mountains, a huge modern swimming pool was built in 1934–35. The complex consisted of an elongated string of symmetrically laid out buildings separating the sports enclave from the access avenue and the city. Low rectangular blocks, light plaster, extensive lawns, standing on the forested slope of Kościuszko Hill testified to modern intensions. The facade layout was ruled however by chaotic diversity. The rhythm of the openings contrasting with the bright basement plaster and rounded forms, brought to mind a white version of modernism. Exaggerated eaves, geometric shapes of the attic facade alluded to art deco aesthetics. The frugal, however still traditional decor of the extreme buildings was complemented by a stiff arrangement of swimming pools and green areas. The bathing area penetrated the scenery of the landscape park at the Paulinum Palace, the City Park on Kościuszko Hill, surrounding hills and the 19th century villa district.

In areas with a varied landscape, in small mountain settlements, it was particularly important to incorporate the bathing area into the individual properties of the area and using its values.

The bathing beach in Karpacz was established in the 30s of the 20th century in the valley flattening of the Łomniczka stream. Shielded with a ribbon of tall trees, it was oriented towards the spectacular southern side – the panorama of the Karkonosze. The foundation axis was emphasized by the historic guesthouse and sanatorium buildings towering on the opposite banks of the stream. The rectangular shape of the basin, blurred by the rounded line in the field, flanked by geometric buildings in which we find art deco reminiscences.

The bathing area in Przesieka was established in the first half of the 20th century, in a gently shaped valley of the Czerwień stream. The natural shape of the water reservoir was preserved by using the existing pond. Rustic, ascetic buildings with arcades, was opening from the south to the ridge of the Karkonosze mountains, with a water reservoir in the foreground. The ground floor was crowned with a gable roof with a slight slope, and a superstructure with a pent roof. The roof served in the same time as a terrace. Extensive grassy spaces penetrated freely the free-shaped path lines. The composition of the layout was emphasized by the building line of boarding houses, huts on the right bank of the stream. The opposite northern slope formed a uniform background of the forest edge.

The bathing area location in Michałowice (Freischwimmbad 'Zum Waldschulmeister'), which was founded in the 1st half of the 20th century, was not accidental. On the hidden level between the slopes of Świerczyna, Grzybowiec and Płoszczań, on one of the tributaries of the Pracz and Brocz Stream, Rudnik, a water body which blended in with the terrain was formed. The reservoir, which was rounded from the north and cut straight from the south on a gently raised slope, was surrounded by natural mountain vegetation. On one side it came into contact with meadows, whereas on the other it was surrounded with spruces. A small backyard pavilion was erected at the southern wharf, which duplicated the standard repertoire of forms, i.e. a flattened envelope roof, a visible columnar and angle brace arcades. An important element of the layout, however, was 'Waldschulmeister' Pension which dominated asymmetrically above the whole. Intriguing architecture, which was kept in a regional convention and adjacent to sports facilities, was a characteristic composition treatment used in the Giant Mountains. The structure, which was covered with a gable roof and a planked attic, contrasted with the light plaster of the ground floor and the gray of the stone basement – the plinth, gave the cultural staffage to the mountain sports layout. It is worth mentioning that cross-country trails from the highest parts of the Karkonosze and neighbouring villages converged here.

4 Summary

The landscape of the Karkonosze mountains and Switzerland abounds in natural environment, enabling the cultivation of many sports: lakes, rivers, mountains. Hundreds of pools were built in Switzerland. In the Karkonosze Mountains, almost every tourist village had its own open-air swimming pool. In Switzerland, bathing resorts served as a social institution and recreational activity, shelter in an unstable political situation. Sport facilities in the Karkonosze played a special educational and recreational role in the natural environment. In both cases, the landscape was given priority as a return to the "lost world".

These were interesting urban and architectural conceptions formed on the one hand with the principles of modern functionalism, on the other set in a romantic tradition, in the spirit of neo-romantic tendencies of the turn of the centuries.

Functionality was given a special concern in the architecture. Although economics was an important criterion as well. Minimalism was not about getting rid of aesthetic sensations or the comfort of experiencing nature. Greenery was naturally shaped,

creating a sentimental environment for frugal architecture. Decorations and sophisticated styles were avoided. There was an extraordinary agreement between traditional and progressive architects in view of landscape values. It resulted from the sensitivity to traditions and nature.

Selected Swiss bathing areas are also distinguished by:

- avant–garde spirit winning in the bright facades of simple solids, flat roofs, in large planes of windows, manifesting enthusiasm for technology,
- conservative garden finesse, floral scenery.

Bathing areas in the Karkonosze are featured also by:

- reformative minimalism in geometric composition, ascetic buildings, modest floral setting with a dominant open sports space,
- incorporation the swimming pools into the area of existing regional architecture and the use of vernacular motifs.

The bathing areas are characterized by their excellent integration into the landscape, topography, nature and viewing systems, thus achieving a consensus of tradition and modernity.

"Nature became the substructure within which these condtradictions of the age could be resolved harmoniously …" [7, p.63].

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The Specificity of the Sports Facilities Concepts in the Karkonosze – A Harmonious Arrangement with the Landscape

Anna Wojtas-Harań(✉)

Faculty of Architecture, Wrocław University of Science and Technology, Wrocław, Poland
anna.wojtas-haran@pwr.wroc.pl

Abstract. A common feature of sports facilities in the Karkonosze (the Giant Mountains) is the use of advantages of the natural environment and harmonious integration into the existing landscape. The authenticity of nature dominating in the concepts of sports devices fully satisfied psychophysical needs for rest and aesthetic sensations and made sports facilities ergonomic in the Giant Mountains. The purpose of the study is to determine the reasons for the creation of sports facilities in the Giant Mountains in the shape we remember and observe on postcards and the remains of which we find hidden in the thickets, which finally function today in urban arrangements and impress us with their ideas. Was it the result of a broader ideology which also contributed to the captivating landscape of the Giant Mountains? The method of observation and study of individual cases was adopted. Examples of the Giant Mountains bathing areas were selected. Attention was focused on outdoor swimming pools dating back to the turn of the century. They created a unique and invigorating atmosphere in resorts, villages, in the highest mountain ranges and in the forests. These objects have been preserved only fragmentarily. Hence, it seems even more necessary to analyse them.

Keywords: Urbanization · Sports facilities · Mountain settlement

1 Culture of Bathing

The history of bathing areas in the Jelenia Góra Valley and the Giant Mountains began almost 800 years ago. Already in the 13th century, hot springs in the region of Cieplice were known for their balneological significance. The culture of bathing and recreation by the water for therapeutic purposes were widespread in the 18th century in Europe [1]. Following the example of the first English resorts and English achievements in the field of public hygiene[1], bathing areas were also created in other regions of the Sudetes which were devoid of valuable springs. In the mid-19th century, medical discussions

[1] In 1755, Dr. Russell, nicknamed 'explorer of the sea', praised water therapies and fought to open a bathing season in Brighton. In 1848, the first National Public Health Act was adopted in England. The first city bath and laundry for workers was opened in Liverpool in 1842.

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were dominated by the hygiene movement[2], which was manifested in the Prussian hygiene legislation and policy as well as in the principles of bathing design. Hygiene enthusiasts referred to the Greek ideal – body and mind cult. Exhibitions which propagated social ideas of the movement were organized. In 1886, the Hygiene Exhibition took place in Berlin, where the model bathhouse of the Oscar Lassar's idea was presented. In subsequent years, similar exhibitions which promoted the culture of German sport and outdoor activities[3] and even had their share in the development of cities, including garden cities, were held. They also contributed to designing architecture in accordance with modern hygienic standards and, consequently, functioning of the movement such as Bauhaus.

Within a few decades, the human ideal of beauty and behavioral patterns changed. In pursuit of perfection, the noble pallor of the skin was replaced by tanned skin. Water, sun and air were used for the therapeutic treatment and sports training. The objects which were used for water, sun, air and light baths gained importance. Appropriately designed areas offered shaded areas for walks, sunny places for having fun, sunbathing, doing physical exercises, sports games, scenic viewpoints for relaxation as well as meals[4].

Types of bathing places were the answer to the new social requirements. Initially, anchored bathing facilities were used off the waterfront. They were accessible by the pier and hidden behind the 'walls' of dressing rooms and washrooms which were available for men and women separately[5].

Along with the spread of the hygiene movement, then the reform of life, along with the emergence of new awareness of the advantages of being outdoors, family and co-educational swimming pools gradually appeared showing increasingly greater simplifications in the architectural narrative[6].

The 19th-century hygiene movement provoked thinking about architecture, which resulted in becoming an important topic of modernism. Clean surfaces and clinical aesthetics were a reflection of this. 'Dirt and disorder – architectural eclecticism were connected with the burden of history in the minds of the avant-garde' [3].

At the same time, artistic means of the native style were not given up. It could express other values such as local traditions, a sense of security, the love of homeland

[2] England was a leader of the sanitary movement. The hygienic movement was founded in 1840. In the 2nd half of the 19th century, German medicine researchers and hygiene reformers such as Max von Pettenkofer, Rudolf Virchow, and Robert Koch contributed significantly to hygiene science.

[3] These were: the International Hygiene Exhibition in Dresden in 1911, the Great Exhibition in Dusseldorf – GeSoLei in 1926, the Exhibition in Dresden in 1930 and many other art and sport exhibitions devoted to health, social care and physical exercises. A success of the events constituted encouragement for the establishment of the German Hygiene Museum in Dresden in 1930.

[4] From 1926 in Germany, swimming classes were part of school education.

[5] One of the earliest bathing facilities of this type was the one founded in 1857 in Ulm on the Danube, which functioned on the principle of the Kneipp method. The river bathing area consisted of cabins supported by stakes. Through a hole in the cabin, a person was lowered into a strong current of the river in order to achieve the effect of centrifuges [2].

[6] In the bathhouse concepts, the emphasis was put on recreation and sport. The city bathhouse which was built in Wroclaw in 1897 according to the design of Wilhelm Werdelman already housed a swimming pool.

[4], which could solve the problems of architecture of sports facilities in small rural centres in the mountains, but not on the urban scale.

A new ideal of the beautiful trained body, which was supported by nature-therapeutic movements as well as by national socialists, encouraged the construction of bathing resorts with large terraces as well as sunbathing and physical activity areas.

2 Concepts of Bathing Places

The pleasure of bathing could overcome the fear of deep waters. However, to eliminate the risk of drowning, the embankments of rivers, lakes and seas were initially developed by means of installing special platforms.

Already in 1799 on the River Wakenitz in Lübeck a river bathing resort was arranged – the Kreidemannsche Anstalt bathing facility. A small, makeshift building and a wooden platform, or bridge, mounted on poles, protruded deep into the depths of the river, created a frame for the space intended for bathing[7].

As a result of searching for new bathing forms, the easiest and cheapest method was introduced – organization of a bathing beach on the existing water reservoir. The sections of the waterfront were secured with shallow access to water and they were equipped with simple infrastructure. Due to the seasonality of the projects, temporary wooden pavilions were constructed, similar to the above-mentioned river structures[8].

The lack of natural reservoirs was compensated by artificial reservoirs[9]. When designing bathing resorts, efforts were made to use existing land predispositions, i.e. existing streams, rivers, slopes, excavations[10].

[7] The Westend bathing area (Städische Strandbad – Westend) designed by Richard Konwiarz was established in Wroclaw in around 1927 by separating the 12/50 m area in the River Oder current and adapting the sloping waterfront for a recreational function. The contrast of bright reinforced concrete cantilever slabs and a dark colour of brick and wood evoked a picture of modern architecture [8].

[8] An example of a solution is a swimming pool built on the Morskie Oko (Leerbeutel See) natural waterbody in Wroclaw [5], which was designed by Richard Konwiarz. The bathing place is another of six open swimming pools, which the city undertook to implement in the years 1927–30. The prosaic architecture of rectangular pavilions covered with a gable roof was emphasized in the central part by a prominent arcade, supported by eccentrically slender columns. The arcade designated a transverse axis of the foundation, highlighted by a semi-circular terrace and a bridge, extending far deep into the sandy beach and the 50-m pool.

[9] Badesportpark Opperau bathing area [6] was founded in excavations after a brickyard in Wroclaw in 1927. The first clay pit was intended to be a gondola pond, whereas in the other one pools were situated: a paddling pool, jumping pool, 100/50 waterbody divided along for swimmers and non-swimmers. On the road's side there was a pavilion of cash desks, dressing rooms and a buffet adapted to the landscape of the flat area. The long low dimensions with a predominance of horizontal lines of eaves extended into the boundless area contrasting with the reservoirs and soaring poplars.

[10] Major investments such as remodelling of the island to create a bathing place were also undertaken. In 1929, the Rheinstrandbad bathing place in Karlsruhe started functioning, which was formed thanks to the closure of the island of Rappenwort on the River Rhine. The investment was part of the progressive social and housing policy of the Weimar Republic and corresponded to the ideas of Volksparks of the 1920s.

In 1930, programs for the construction of swimming pools with standard exercise and competition pools were developed. 3600 pools of this type were planned in the whole Weimar Republic [7]. Usually, this kind of layouts consisted of a set of architectural solutions, i.e. rectangular pool basins, grassy recreational spaces, sometimes surrounded by high greenery, clear composition suited to natural and landscape conditions. The concepts used a typical rule – the location of the locker building on the edge of the bathing places as barriers against the external environment or the dressing rooms was connected to the entrance building often emphasised with a clock tower. The great crisis which followed the economic acceleration of Germany in the mid-1920 s could have had a restrictive effect on bathing architecture, making it more minimalistic. Solutions in modernist stylistics were encountered and inspired by native technologies. Greenery always played an important role in the concept of layouts.

3 The Giant Mountains Bathing Areas

In the mountains and foothill areas in Lower Silesia, due to the individual properties of each location, less formalized compositional and spatial layouts were founded. Bathing resorts were usually arranged in an artificial or natural water reservoir. Similarly, as in the examples described above in larger urban centres, the land values were adapted.

The bathing places which were built in the Giant Mountains region and the surrounding areas were as follows: mountain swimming pools – the *Bergbad*, forest swimming pools – the *Waldbad*, beach swimming pools – the *Strandbad*, swimming pools on the island – the *Inselbad*, garden swimming pools – the *Gartenbad* [11] depending on the terrain characteristics.

Beach swimming pool in Cieplice

The swimming pool in Cieplice (Freibadeanstalt Bad Warmbrunn) [8] was established at the beginning of the 20th century and constructed on the existing water body at the Młynówka Stream – a tributary of the Kamienna River on the northern outskirts of Cieplice.[11] At the end of the 1920 s, as a result of remodelling, the facility became an impressive sports complex with a stadium, shooting range, sports fields, and a mosaic of connected water panels. A 100/25 m rectangular swimming zone was separated on the largest reservoir. In 1927, the design of the stands along the longer eastern side of the swimming track was created. They were symmetrically surrounded by representative two-storey buildings with galleries.[12] From this place the view overlooked a water complex, vast grasslands fancifully developed with bridges, dikes, sandy paths

[11] Postcards from 1915 show the already developed water body with wooden platforms and makeshift wooden one-storey buildings covered with an almost flat roof.

[12] On the first floor (at a height of about 6 m above the surrounding area) there were locker rooms and showers. On the ground floor (at a height of about 2 m), cloakrooms rooms and toilets were located in the arcades. The wooden structure was supported by prominent concrete pillars. Perpendicular to the water complex, a shooting range building with the adjoining buffet and colonnade was planned in 1928.

with smooth windings, ribbons of beaches, peninsulas – beachheads for sitting and resting. The whole was 'bathed' in the scenery of the Giant Mountains.[13]

Mountain/beach swimming pool in Karpacz Górny

The bathing area in Karpacz (Strandbad Ruebezahl) was established at the turn of the 1930 s in the hollow of the Budnicza Struga Valley. The rectangular basin of the pool on a flattened platform, surrounded by a wide range of meadows, evoked associations of a great stage and the slopes of the valley ran towards the east like in the amphitheatre – a huge audience. The mountain landscape imitated scenography. Above, on the southern side, like 'on the swallow', villas and pensions surrounded by groups of trees dominated (including Villa Habmichlieb – 12 Karkonoska Street, Villa Hedwig – 5 Linowa Street, Haus Anna – 10 Karkonoska Street, Hotel Rubezahl/Morskie Oko – 7 Karkonoska Street). On the northern side, the recreational area was isolated by a forest wall leaning on the slope of Saneczkowa Mountain. The L-shaped development which centred around the west-southern corner of the plot created a quiet corner for those who enjoyed sunbathing and were tasters of the café specialties. The second terrace which was situated on the roof of the building uncovered a spectrum of views of the Giant Mountains range, the Łomnica Valley and its tributaries. The rectangular, one-storey bodies of locker rooms and restaurants dominated over the water surface, snuggling into the north-eastern slopes. The simplicity and laconic character of the sports facility did not interfere with the picturesque development of Karpacz, which used the local construction tradition. It should be added that in winter the facility was used as an ice rink. A little above there was a ski jumping hill and a ski slope, whereas along Karkonoska Street there was a sledge track.

Swimming pool on the island/garden swimming pool in Kowary

The bathing resort in Kowary (Inselbad Schmideberg) was established at the beginning of the 20th century, on natural water reservoirs by the Jedlica Stream drainage basin. The concept of incorporating recreational areas into virgin rush and water plants, majestic dendrological specimens, referred to the design tradition in a spirit of harmony with nature. This principle was followed when creating the palace and park layouts in the Jelenia Góra Valley at the end of the 18th century. In this natural environment, conditions for water sports enthusiasts were created. A platform separating the quarter for swimmers and a jumping tower were installed as well as sanitary facilities were provided. In the remaining part, which was diversified with a natural island, decorative bridges, arbours, flower marinas, people boated and walked. From various places of the park and from a wide water surface, there were distant perspectives on the massif of the Giant Mountains and its highest Mount Śnieżka. The layout was extended to include a sports field (today a sports stadium). Nearby there was a sledge track leading from the former mountain village of Budniki. Probably lugers

[13] In 1934, plans for the construction of a sports building complementing the existing infrastructure of the sports complex were developed (locker room, bar, sanitary facilities). It was interesting to use elements of the Norwegian style which already appeared in the local landscape. Referring to the Norwegian Pavilion (built in 1906 in the nearby Füllner Park), horizontal logs were used which were joined in the nodes with a decorative carpentry joint and a granite plinth made from rough blocks. Large sliding windows provided abundant interior lighting and a view of the stadium and the bathing resort.

sledding from at least four other tracks on the slopes of the Karkonosze and Rudawy Janowickie stopped here. In this strategic place there was a railway station, where from 1882 amateurs of winter and summer sports arrived.

Forest swimming pool in Szklarska Poręba

The swimming pool at Hala Szrenicka in the water basin of the Kamieńczyk Stream, which was located at a height of 1,190 m above sea level, became the highest bathing resort in Central Europe. Irregularly shaped and embedded in the thicket of the forest, it differed from the geometric layouts in Karpacz Górny, Szklarska Poręba or the spatial layout in Cieplice. The swimming pool at Hala Szrenicka was situated in the vicinity and at the height of Na Hali Szrenickiej Shelter, constituting its unusual attraction.

Forest swimming pool in Szklarska Poręba Dolna was established in the water basin of the Szklarski Stream. A 20/50 m geometric basin was exposed on the ground podium of the southern slope of the Jizera Mountains. It was accompanied by a simple locker room pavilion with template architecture, i.e. vertical formwork, a hip roof, small windows. A sunlit area of the free space among forests was oriented on the scenery of the mountains and direct contact with the world of flora. Above the bathing resort, tourist traffic concentrated in Dachsbaude Shelter as well as the station of the scenic railway route which reached as far as here since 1902. Apart from forest locations, tourists were attracted by sledge tracks, cross-country trails, ski jumping hills and popular shelters situated nearby.

4 Summary

Social changes became a pretext for changes in the natural and urbanized environment. Bathing areas were a kind of particular innovation at the time when health and physical culture improving practices were implemented. They were built in cities, towns and remote mountain areas of the Giant Mountains. Spectacular locations were chosen for them. The basic element of bathing resorts, i.e. water influenced the aesthetics of the landscape, combined development with the landscape and enriched values of architecture. In smaller towns, light wooden architecture prevailed, whereas in cities it tended to be more massive and often made of stone. It was characterized by conciseness and, in a sense, repeatability. A common principle was openness to light, water, space and greenery. The main function of a bathing resort was extended by spaces for other popular entertainments by installing appropriate devices such as ski jumping hills, playground slides, sports fields, and squares for games. Mountain bathing areas were characterized by individuality to a larger extent, resulting from, among other things, a demanding location. However, there are features that make them recognizable:

The layouts were blended in with the surrounding nature, connected with historic development and other sports devices;

They were usually located in some distance from the town centre. The choice of place depended on the proximity to a strategic, exposed tourist object and the characteristic natural landmark, i.e. water, greenery, topography;

Most of the buildings were designed according to the rules of the native style. Some were characterized by the Bauhaus ethos;

Modernist and hygienic movements which were gaining popularity were integrated and expressed in their approach to the development of the bathing area. Vast water spaces for bathing, sunbathing and air baths reflected the affirmation of nature, the idealization of sterility in connection with sports hedonism;

The development and greenery were characterized by simplicity. Minimalist pavilions without decorations and decorative greenery, sandy and grassy open spaces were aimed at contemplating views. Only the colours constituted a slight revival here.

In the solutions of the Giant Mountains bathing areas the following aspects were skilfully adapted:

- the then competing opposing architectural styles, i.e. modern and regional,
- different functions: contemplating the mountain landscape and practicing new types of sport,
- schematic design principles used in, among other things, the capital city of the region and an individual design approach.

The apparent contradiction created a harmonious layout with the landscape.

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Human Factors in Shakespearean Theatre Architecture

Paweł Amałowicz(✉)

Faculty of Architecture, Wroclaw University of Science and Technology,
B. Prusa 53/55, 50-317 Wroclaw, Poland
pawel.amalowicz@pwr.edu.pl

Abstract. Shakespearean theatre is a performing arts and theatre architecture phenomenon. Auditorium and stage arrangements in such buildings are specific and unique. It was the English renaissance theatre that introduced the human scale into the relation between the spectator and the actor. A strong bond was formed between the artists and the audience in the Elizabethan theatre. There are many stages today that operate without draw curtains and still resemble stages from the Elizabethan theatre. The author will be analysing modern theatre formats of this type. He will also examine whether such architecture could respond to artistic demands of non-Shakespeare drama performances or other types of events. The important issue is how and to what extent Shakespearean theatres may affect the spectators' reception of the show. The study of several factors having a positive impact on every member of the audience within such buildings is the main purpose of this paper.

Keywords: Shakespearean theatre buildings · Modern theatre architecture · Stage and auditorium

1 Introduction

The English renaissance theatre, also known as Elizabethan theatre has evolved in the second part of the 16th century. The peak period of its development coincides with the last two decades of the rule of the Queen Elizabeth I[1] and also with high point of William Shakespeare's work. The Elizabethan theatre owed his success, popularity, spontaneousness and dynamics to Shakespeare and other authors of that period[2]. That theatre was remarkable in many ways. First of all, it was a distinct structure, different from the Italian theatre in terms of a stage and an auditorium arrangements. Origins of those two theatre formats were also different[3]. The Elizabethan "theatre space – although an original and independent creation – also absorbed the best aspects of past traditions: the ancien t tradition (open performing space surrounded on four sides by an auditorium), the medieval tradition (with its mansion stage) and the folk tradition,

[1] Elizabeth I was Queen of England from 1558 until 1603.

[2] Among others to Christopher Marlowe, Thomas Kyd, Robert Green and George Peele.

[3] The Italian theatre with its proscenium stage was based on the court theatre.

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which determined the tremendous popularity, democracy and vigorousness of this theatre and, most importantly, the direct contact between the actor and the spectator" [1]. Secondly, Elizabethan theatre formed its own, specific type of drama presentation and also introduced a unique theatre space with strong influence on the spectator. Original and specific form of the Elizabethan theatre survived only several dozen years. But its influence on the theatre productions and contemporary theatre architecture cannot be overestimated. This paper analyses Shakespearean theatre space and study all those factors which affect 'human' aspect of theatrical productions in such buildings.

2 The Elizabethan Theatre

The Shakespeare's theatre was not an elite place. It was a versatile and egalitarian venue. At the beginning of the Elizabethan era, plays were produced in such spaces like the courtyard of an inn. In inns and taverns in renaissance England a galleried yard was very common. The open-air inner yard was a space for a performance and two-storey galleries were a space for an audience [2, p. 114]. The word 'theatre' had been in use originally in relation to the platforms used for the temporary stages erected in inn-yards. From such staging, the Elizabethan theatre evolved with a stage open towards the surrounding public. The Elizabethan theatre buildings were polygonal in plan[4], almost circular. They were rather small – their diameter did not exceed 30 m[5]. Despite their small sizes Shakespeare theatres could house from 1500 up to 3000 audience members. Those theatres incorporated the inner, open yard and galleries. Galleries in theatres 'The Globe' (built in 1599) and 'The Swan' (built between 1594-96)[6] formed three covered levels, which overlooked the open centre with the stage. The stage of Elizabethan theatres comprised three main elements: a front stage or a protruding open platform sheltered by a roof, a rear stage and an upper stage. In most theatres the stage roof, supported by two pillars set midway between the front of the platform and a stage wall[7]. The floor of the stage was raised three to five feet above the yard and supported by pillars or trestles. The width of the stage varied from 20 to 45 feet and the depth from 15 up to 30 feet. In 'The Globe' theatre platform was rectangular in plan, sticking out into the middle of the yard[8]. The rear or 'inner below' stage with a stage wall, or the 'frons scenae' had a clearly defined form. There were always a large central door and two secondary doors either side. Above the doors, on the first floor, was a pillared cloister that was used either by musicians, or by actors. It was the upper stage determined also as 'upper above'. The inner stage was a part of a 'tiring house'. The 'tiring house', backstage, was used for different purposes, mainly as a dressing room for actors

[4] Such was 'The Globe'. It was rebuilt in 1997 in London as twenty-sided polygon. 'The Swan' and James Burbage's playhouse – known simply as 'The Theatre' were similar in shape.

[5] 'The Globe' was approx. 100 feet in diameter. 1 foot = 30.48 cm.

[6] 'The Swan' was the fourth in the series of large public playhouses in London, after James Burbage's 'The Theatre' (1576), 'The Curtain' (1577) and 'The Rose' (1587-88).

[7] But in 'The Globe' the roof covered the whole platform (according to the reconstruction).

[8] The stage platform of 'The Globe' was approx. 13 m wide and 8 m deep. It was raised 1,5 m above the yard.

and a waiting room for them, but also partially as a part of a stage. Above the upper stage was the canopy of the 'Heavens', a place hidden from the audience, for the actors to hide, brilliantly painted from the outside. Panels of the canopy were painted to represent astrological figures, the sun and the moon, stars and clouds. A selection of ropes and riggings would allow for special effects, such as 'flying'. Two main oak 'Herculean' pillars supporting a canopy framed the stage. Pillars looked like Italian 'antico rosso' marble with gold leaf Corinthian-style capitals and also a 'frons scenae' pillars and other elements were decorated in that way [3]. Below the stage platform 'Hell' was located, accessed by actors through a central trap door. The whole stage form reprised a medieval tradition of a mansion stage. The platform was later called an 'apron', especially during the Restoration period. The front stage was mostly used by artists during the performance. It reached out into the auditorium and was clearly visible by the audience. This made a dynamic performance space that created exciting visual opportunities. The Elizabethan stage was flexible. The empty space, that was extended out into the audience and could be viewed from three sides, could be one place, and soon another and another, in rapid succession, without changing a thing. Shakespearean stage did not have movable stage scenery or painted backdrops like an Italian theatre. Actors did not use many props either.

The Elizabethan theatre audiences attracted people from all classes – nobilities and commoners. Nobles usually sat on galleries[9] and commoners stood in the theatre yard (called also a pit). Each level of gallery had three or four rows of seats or wooden benches, to be more precise, with a proper height. The seats had no backs and the audience could be squeezed in without restriction. Galleries were opened towards the stage and the seating was positioned on an upwards slope away from the centre of the theatre, so almost each member of the audience could see properly the performance area. The seating slope were often as much as 45°[10], what provided very good sightlines from the upper seats. People standing on the yard were very close to the stage and were surrounding it from three sides. All audience members were never far from the action on a front stage, even when seated in the upper gallery, which created a special intimacy between the actors and audience. Their proximity was affecting the character of the performance – Shakespearean monologues were actually "an intensive dialogue with the audience – very close conversation, in which the agitated audience was involved silently and Hamlet's dilemmas were adopted by them as their own" [2, p. 122]. The audience was, for its era, very democratic: nobilities and commoners were watching the same performances, although those wealthier on galleries, poorer on the yard, but all of them in one common space. Additionally, a strong bond was formed between the artists and the audience and the atmosphere of the spectacle was emphasised by the open, uncovered space of the inner courtyard.

The later history of English theatre, starting from the Restoration (after 1660), has shown that buildings for the performing arts had begun to incorporate representative elements of the Italian proscenium stage. Only the apron remained from the Elizabethan era, but it was reduced over the years and finally disappeared in the 18th century.

[9] Some of them also in the 'Lords Room', which was situated in the same space as the upper stage.

[10] Modern legislation restricts the slope up to 30–35°.

3 The 20th Century Return to the Stage of Elizabethan Era

The gradual return to the Shakespearean theatre took place in the 20th century. In the 1950s and 1960s there were attempts at resurrecting the concepts of the Shakespearean theatre. The return to the stage of Elizabethan times was promoted by Tyrone Guthrie, who believed that a "great gap" had been formed between the artists and spectators. According to Guthrie, elements separating the actors from the audience included not only the orchestra pit but also the proscenium arch and the proscenium stage itself. This is because the proscenium arch enabled only a 'two-dimensional' projection of the performance. Guthrie found that Shakespeare's dramas were not suitable to be staged within such a confined framework. Theatres erected in accordance with his concepts, i.e. the Shakespearean Festival Theatre in Stratford, Canada (1957), and the Tyrone Guthrie Theatre in Minneapolis, USA (1963), had thrust stages, extending far towards the audience and surrounded by a concentric and amphitheatrical arrangement of rows, referring to the antique, classical Greek tradition. Guthrie cooperated with Tanya Moiseiwitsch, an English theatre designer. The thrust stage designed by her in Stratford revolutionized the modern performance of Shakespeare. In her project she was inspired by the Elizabethan apron stage. The stage was comprised of a protruding platform, a balcony, trap-doors, nine acting levels with stairs and eight major entrances. It was stepped along its leading edge to allow case of movement through the audience onto the stage.

The theatre in Minneapolis was designed by Ralph Rapson with collaboration with Moiseiwitch[11] and had also open thrust stage. The building was planned from the inside out. Designers and Guthrie wanted to dissolve the boundaries between actor and audience member. They designed an asymmetrical open stage surrounded by seating on three sides, so it formed a 210-degree arc like in ancient Greek amphitheatres, and the rake of the auditorium was steeper on one side[12]. That arrangement helped to improve the interaction and the interrelation between audience members. Both Guthrie's theatres placed the audience in the same space as the performance and furthermore they placed the audience closer to the acting area than the proscenium stage formats.

The open stage like the thrust stage was the oldest known type of fixed staging. The ancient Greek and Roman amphitheatres had similar stage configuration. Also the Elizabethan theatre stage was of this type. The thrust stage is still in use in the 21st century because of the theatrical energy and tension it creates with the actors and

[11] Tanya Moiseiwitch who had been involved in designing Guthrie's theatres, designed another thrust stage in the Crucible Theatre in Sheffield, England (opened in 1971).

[12] Rapson design was remarkable also because of its colourful seating (seats were covered in an array of brightly hued fabrics) and the outside theatre architecture, which was characterized by geometrical forms made of glass curtain walls covered by a freestanding, light screens.

audience in close proximity to each other [4]. That structure provided a 'three-dimensional' perspective of the performance and brought the performing space closer to the auditorium[13].

4 Contemporary Shakespearean Theatres

An open thrust stage or an apron stage is popular in modern drama theatre buildings. Also those arrangements where the audience surround the stage on three sides are popular nowadays. Sometimes the seating form galleries which resemble those structures built in the Elizabethan theatres. Such neo-Shakespearean theatres were constructed in recent times, e.g.: the Gdańsk Shakespeare Theatre, Poland (2014), the Hardelot Elizabethan Theatre, France (2016) and the Yard at Chicago Shakespeare, US (2017). The Gdańsk Shakespeare Theatre, opened in 2014, is a perfect example of such facility. English companies of players were visiting Gdańsk in the early 17th century at least thirty times. A first public theatre was built in Gdańsk around 1611 and was similar to one of London playhouses, precisely to 'The Fortune', which was built on the plan of a square [5], uniquely among the period's theatres. "This theatre, called the 'Fencing School' was a multi-functional building in which, apart from fencing exercises or shows and theatrical performances, other types of entertainment were presented" [5]. The outer shell of the contemporary theatre evokes the architectural past of the city (red-brick Gothic churches dominate in the old town) [5] and resembles in its form and in a colour scheme an old building of the 'Fencing School'. This solid, heavy, dark charcoal brick box is keeping inside a delicate wooden structure of the theatre (Fig. 1). The plan of a theatre is also a square like it was in the 'Fencing School'. The roof over the theatre could be easily open[14], if necessary, to enable the open-air Shakespearean performances. It is a functionally flexible theatre, and provides different variants of stage and auditorium configuration for the purposes of theatrical and extra-theatrical presentations. The basic arrangement is the Elizabethan configuration with the open thrust stage extended to centre of the yard, which is dedicated for standing spectators. Galleries form three stories of the fixed seating, made of wooden benches, for about 600 people. In plan, there are six modules on the two long sides and five on the one short side, making a C-shaped figure. The stage movement technology located in the base below the floor slab enables transformation of the stage into the Italian configuration with the traditional proscenium stage and also with the raked ground floor seating. It is a mobile stage, almost in response to the wings of the roof. The other possible arrangements of the theatre are: experimental configuration with a central stage, ceremonies configuration with a flat floor and a fencing arrangement with a fencing strip.

[13] In the theatre in Minneapolis, the distance from the centre of the stage to the furthest points of the auditorium did not exceed 18 m, despite the fact that the theatre had 1.437 seats. In Stratford Festival Theatre the total capacity was over 1.800 seats, yet no spectator was more than 22 m from the stage.

[14] It takes approximately three minutes to open both wings of the roof structure. When the wings are opened straight up, the edges reach a height of 24 m.

Fig. 1. The interior of the Gdańsk Shakespeare Theatre, Poland (left), www.uncubemagazine.com

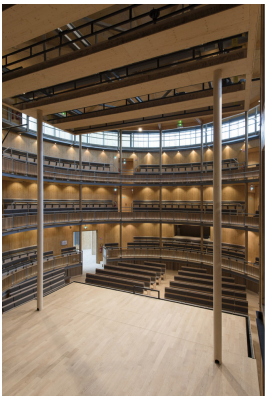

Fig. 2. Hardelot Elizabethan Theatre, France: view from the thrust stage to galleries (right), www.archinew.altervista.org

There are even more complex structures within the neo-Shakespearean theatres, with more flexible interiors. The Yard at Chicago Shakespeare is such example. The design features nine mobile audience 'towers' (units), each containing three levels of seating, that can be arranged in a wide variety of ways (9 different configurations: among them two types of thrust stages, end stages, theatre in the round, traverse stage). A movable set of structural audience 'towers' create a new type of performance auditorium, one that can be adapted to the artistic vision of the director or designers. Compressed air skid technology lifts each of the 16 tonne 'towers' off the ground on a bed of air, allowing them to be moved by a three persons. That flexible hall can be configured in a variety of shape and sizes, with audience capacities ranging from 150 to 850.

Both theatres, in Gdańsk and in Chicago, are venues that need adaptation and physical change of the stage and auditorium to satisfy their requirements. The last example of the neo-Shakespearean theatre – Hardelot Elizabethan Theatre, situated near Calais in France is smaller and more simple. Its cylindrical structure is composed of geometric forms and made of cross-laminated timber panels with bamboo poles used as an outside ring to form a buffer zone between its exterior and interior. Inside, the theatre has almost 390 seats in its standard 'Shakespearean' format with the apron stage, but it could be changed to an intimate opera house with the use of an orchestra pit and stage wings, which reduces the total capacity to 290 seats. The size of the building[15], its form and materials evoke the simplicity and timelessness of its historical predecessors (Fig. 2).

[15] The building is similar in dimensions to the Elizabethan-era 'The Rose' (approx. 72 ft).

The author's analysis of visibility in all three theatres reveals small disadvantages when galleries are used as a seating for the proscenium stage configuration. Those problems occur especially in a horizontal plane, because pillars supporting gallery levels could restrict a field of vision from some seats. That could be compensated by a polygonal plan of gallery levels[16]. Also the audience view of the stage from seats situated close to the junction of auditorium and backstage is not very good, especially from upper levels. For the Elizabethan configuration and other arrangements with the thrust or central stage those disadvantages disappear - sightlines in vertical and horizontal planes are correct. It can be said that these theatres are a multi-form facilities. A dominant type of production is drama, but with more than one type of arrangement for the relationship between audience and performance within the same enclosure [6, p. 110]. Their unique solutions draw inspiration from Elizabethan-era theatres, when audiences directly engaged with actors, but also offer performers an opportunity to adjust the scale and provide the proper type of production.

5 Summary and Conclusions

The Elizabethan theatre implemented a few significant elements to a theatre space and left a mark in a theatre history and architecture. The open apron stage, an inner yard and galleries for the audience enabled 'three-dimensional' projection of the performance instead of 'two-dimensional' of an Italian proscenium stage. The inner space of the theatre was devoid of any artificial barriers, and it did not separate the spectators from the artists on stage. Stage movement on the apron stage was much more distinctive than on the proscenium stage. The optimal audibility and visibility of performers was ensured by a proximity of a stage, unlike in the large baroque opera houses. It was also guaranteed by configuration of galleries in a vertical projection (raked seating), as well as in a horizontal projection (audience partially surrounding platform). Audience members could observe facial expression and even small gestures of artists and the interrelationship between the actor and the spectator was reinforced. They could also see each other while watching the action on stage. This created "an interesting experience for spectators, seeing the reactions of the people on the other side of the stage and knowing they are seeing the show from the opposite viewpoint" [4]. These human factors implemented by the Elizabethan-era playhouses are of great importance to a theatre as a whole.

The 20th century search for the optimum theatre space led to the appearance of contemporary adaptations of the thrust (apron) stage, which was characteristic to Elizabethan theatres. The contemporary neo-Shakespearean theatre implements a more flexible architectural space which increases its influence on the audience. It also maximises the audience viewing experience, comfort and acoustics. The flexibility is useful also for different types of presentation, like concerts, lectures or conferences.

[16] In the Gdańsk Shakespeare Theatre, however, galleries are shaped in an orthogonal plan.

Shakespeare wrote his plays for a thrust open stage theatres and for this reason such theatres are being built today. But they are also popular nowadays, because such structures strengthen the sense of the art of a drama performance.

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Ergonomics and Material Environment Design

Private Environment of a House with a Courtyard: An Example of the House Located in Kemer in Turkey

Jerzy Charytonowicz[1,2] and Alicja Maciejko[3(✉)]

[1] Angelus Silesius University of Applies Sciences in Walbrzych, Zamkowa 4, 58-300 Walbrzych, Poland
jerzy.charytonowicz@pwr.edu.pl
[2] Faculty of Architecture, Wroclaw University of Science and Technology, Wybrzeze Wyspianskiego 27, 50-370 Wroclaw, Poland
[3] Institute of Architecture and Urban Planning, University of Zielona Gora, ul. Prof. Z. Szafrana 1, 65-516 Zielona Gora, Poland
alicjamaciejko@wp.pl

Abstract. The article discusses the characteristics of functional and spatial solutions of a house no 86 in the village Kemer Mahallesi in Turkey taking into account the closed nature of the building in which the inner courtyard was created. Aspects of private space and the environment that is created in the house and the courtyard separated from the street by walls is analyzed. Closed, intermediate space is not a phenomenon commonly used in the residential architecture of Europe. Does isolation of space have a negative impact on users' feelings or, on the contrary, creates a space where the sense of privacy and security is strengthened? An analysis of the house with the presentation of the functional layout, technical condition analysis, architectural details, construction and interior design solutions is also included.

Keywords: Private space · Turkish house · Closed house · Interiors · Introversion architecture · Quality of life · Human factors

1 Introduction

The article discusses the characteristics of functional and spatial solutions of a house no 86 in the village Kemer in Turkey located in the area of the research on the architectural heritage in Manisa Salihli region. In the village there are original buildings from the Lidian period and houses from the Ottoman times. It is one of the best-preserved houses, where architectural elements were not replaced during the renovation. The main aim of the general research of village Kemer is to examine the urban concept its transformation, as well as the analysis and documentation of building technologies, functional solutions and interior details. However, in the process of research an interesting aspect of the closed plans houses was revealed. In the village there are several such houses from the Ottoman times of high architectural value, some of them are still in technical good condition, with original details, allowing for reconstructions (Fig. 1). The analysis of the spatial solutions of these houses showed that in each of

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them, in the inner courtyard separated from the road by stone walls and a decorative gate, a different private environment was created. There were gardens, stone floors, places for cooking and preparing meals, baking ovens and taps with water, fruit and olive trees, places for animals, drinking troughs, and storage space for food and firewood, which were burned in ovens and heated houses. The house no 86 is a two-storey house with a relatively small living space compared to other, more affluent houses. It is located in an enclave closed from the street, creating a private environment (Fig. 3). Inside, a charming courtyard with a garden has been created.

The article discusses an important for architecture problem of the quality of life in historical buildings with, very strong decorative and characteristic spatial solutions, including the living in isolated environment, dominant natural materials and vegetation that are inseparably present. How can closure affect quality of life and comfort in the aspect of psycho-physical feelings? Haw the shape of the house space structure influences to inhabitants emotions, make them happier or contribute to a sense of closure and isolation? It is also an analysis of the house no 86 with a presentation of functional layout, architectural details, construction and interior design solutions.

The definitions of the traditional Turkish house and typology is not discussed in this article. The topic is not new and has already been described many times The terms of a Turkish house or an Ottoman house are widely analyzed, but no clear description can be given that which would be suitable for this particular house. The concept of Ottoman house is undoubtedly connected with the politics and ideology of the Ottoman period, which dominates culture. Equally strong is the connection between the Turkish house and Islam [3]. An architectural solutions are also connected with the geographical and historical factors of shaping this place.

2 Research Problems Related to Location and Existing Buildings

The house was built at the beginning of the 19th century but the author did not reach the archival projects, this knowledge is based on the knowledge of the current residents of the house.

Fig. 1. Location of the village Kemer in mountain area [1]. Plan of the village Kemer, location of the house no 86. Drawings: Alicja Maciejko [1].

The following problematic topics were identified:

(1) A detailed inventory and assessment of the technical condition of the buildings is necessary. In the initial inventory, buildings of particular architectural value were distinguished, e.g. a commercial house with an original wooden facade, and several residential houses, including the house No. 86. The nature of the development is related to the functioning of the settlement; these are primarily residential buildings, including large residential houses and commercial buildings, because in the past the village of Kemer was an important commercial centre. Today, the shopping street has most of the shops closed [2].
(2) Technical aging of houses and depopulation, disappearance of functions.
(3) Investigating the historical tissue, postulate to subject the landscape to conservator's protection.
(4) A characteristic form of housing is houses based on closed plan, what is interesting as possible inspirations for designers of European countries. Already Le Corbusier, the creator of the Modernism, searched for architectural inspirations in Turkey (Fig. 2).

The design of a house plan usually follows the following guidelines:

– type of site
– neighborhood of buildings
– formal and legal requirements concerning the development, e.g. historical buildings
– access to media infrastructures such as water, energy and waste water disposal functional program
– aesthetic preferences of the users
– technical challenges, e.g. a zero-energy house.

There is also a design space left to the designer, which includes design decisions concerning the form, design idea, materials, the way the house functions.

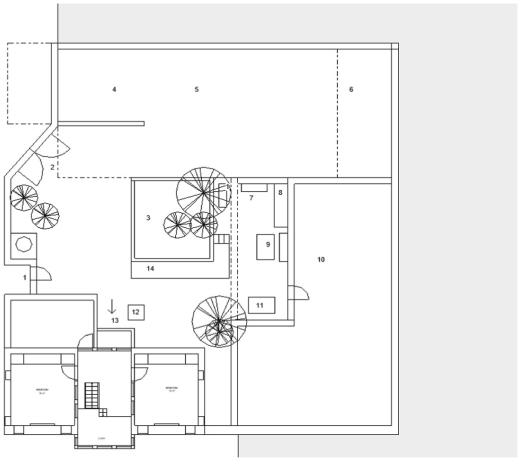

Fig. 2. The plan of the courtyard. Drawing: Alicja Maciejko [1].

Fig. 3. Entrance doors and gate, from outside and from inside. The materials used are a whitewashed wall made of stone, a roof over a door made of wood, a balustrade of a terrace made of perforated brick. The door and entrance gate are made of steel. Back walls of the house, view from the streets. The ground floor is heavily built-up. There are practically no windows on the ground floor. From this side the house is a closed fortress, fenced with a 200 cm high stone wall and does not show its internal composition. Photos: Alicja Maciejko, 2018.

Very interesting and inspiring is the questions what the closure of the house the is result of,

- a decision resulting from the development (small plot in the city center)
- introvertism of the users (my house is my fortress)
- traditional religious customs (private zone for women in Islam)
- formal search (house as a closed sculpture composed in the field),
- solutions resulting from climatic conditions (creating shadow in the open zone or protection from the wind)
- requirements of isolation and safety (e.g. protection against wild animals).

Each of these reasons contributes to the creation of an insulation space, which is different from traditionally built houses. The presented house is located in a complex of houses fenced from the streets, the buildings were built over the course of many hundreds of years, the house in question has utility spaces, where previously standing houses, remains of walls, chimneys are now used in a different way. It is not possible to clearly define the reason for the closure of the function, but it is highly probable that it was connected with safety reasons, terrain conditions and culture related to Islam. The result of these factors is a house in which an intuitively designed place to live was created, although it must be admitted that the house itself was designed by a professional with a great deal of technical knowledge and attention to all functional details.

3 Houses on a Closed Plan. The Role of the Courtyard

A closed house is not a new phenomenon in architecture. There are classic closed-plan houses open to internal space, both historical examples and the latest projects. It was used intuitively as a safety function, but nowadays it is one of the minimalist architectural trends. The external form is reduced to cubical solids that cover the intimate

interior There have also been realized houses which do not have any windows on the outside, only the entrance door or innovative houses that have movable walls. After closing, they complete the urban structure of the space, creating a closed courtyard (for example at night), expanding the safety zone. In these houses, windows are design towards the interior courtyard and the garden. A characteristic feature of such houses is the creation of an internal private zone. Private space is traditionally related to living space. As a rule, there is a place inside the house, accessible only to residents, as opposed to the outside space, which is open, accessible or public.

The intermediate space between the entrance to the property and the intimate living zone, which is at the same time the limit of accessibility, can take different forms. Sometimes this boundary is completely lost, as is the case with the idea of an open house. Where the link with the external landscape is part of the design concept. The house is open in the ground floor, glazed, sometimes accessible directly from the street. Other numerous forms of indirect space are connected with the arrangement of the plot of land on which the house stands, such as elements of small architecture, fences of varying degrees of transparency, greenery, in the form of shrubs or hedges. From the side of the entrance, the intermediate zone usually takes on a more representative character, there may even be decorative gates. At the same time, the form of the house is visually accessible from the outside, the design concept and the zones of the space can be easily read out.

4 Interiors

The interiors are designed in such a way that they integrate functional elements with the elements of furnishings, seeing a great fondness for ornamental details, which are used in wooden elements of wardrobes, walls, windows, shelves, mirrors, entrance doors, shutters, ceilings. Another interesting solution not traditionally used in the residential architecture of Western Europe are the walls separating the corridor from the sleeping rooms on the first floor where windows with shutters are located, as shown in the picture. The equipment of the rooms is the same. They have a square plan. On the wall from the side of the courtyard (entrance) in the ground floor there are windows and on the opposite side there is a wardrobe built into the wall, which covers the whole width of the room. Interestingly, the layout for rooms on the first floor is symmetrical, i.e. the windows are located from the outside street side and the wardrobe from the courtyard and terrace side. Wide corridor, which has a communication function, is also intended for the common part of the so-called mooring, which is located on the elevation and has representative glazing from the street side, which is also shown on the drawing. Cumba functions in the house until today. There are seating mats and a traditional round metal table (Figs. 4, 5 and 6).

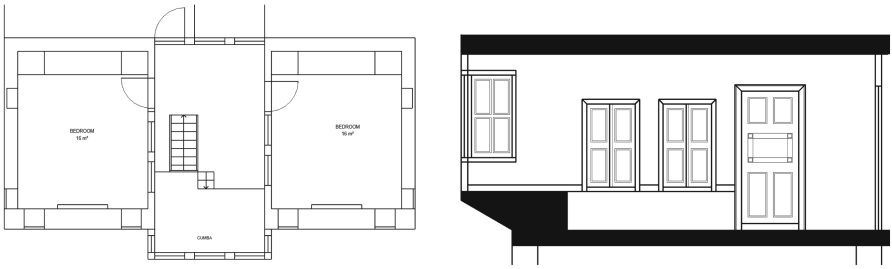

Fig. 4. The plan of the first floor. A building details, two symmetrical entrance wall between corridor and bedrooms on the first floor. Drawings: Alicja Maciejko [1].

Fig. 5. Wooden ornaments of the walls and windows. Photos: Alicja Maciejko [1].

Fig. 6. Interiors (2018). Photos: Alicja Maciejko [1].

5 Summary

It must be concluded that the space between the interior and exterior which was created in house nr 86 was attractive and necessary for the lives of the inhabitants of those times. An intermediate space between privacy and public spaces, which opens up space for additional activities related to housekeeping, important for the quality of life, especially in the modern world of city inhabitants, where all home-made production has been completely stopped. According to the author, such a defined space is

extremely interesting, has a lot of charm of "mysterious gardens", and creates space for life-enriching activities such as food production and preparation, mini workshops for small domestic productions, a place for living plants and animals, eating meals, rest and recreation. However, and this is very important, it is inseparably linked to the strong structure of the family that lives in the buildings. In order to be able to live comfortably in a closed space without feeling isolated and lonely, strong interpersonal relationships are necessary to fill it with the life of a small community. In a similar way, such a space was constructed in monasteries. Meanwhile, such villages in the provinces are depopulated, cultural and economic changes have changed the standard of living, and young people choose to work in offices. In houses with inner spaces where life has been going on, old people are closed from the street with a wall, which creates deep loneliness. It is slightly better in a situation where they have the opportunity to participate in the life of the local community in public spaces.

The inventory shows four equally important aspects:

(1) Normal live in the area connects with problems of visible and technical degradation of architectural elements, what is uncomfortable, particularly when it comes to low insulation of buildings. Historic wooden windows and window structures are replaced by plastic or closed with full walls in a spontaneous and uncontrolled process.
(2) Designing, revitalization and reconstruction in the existing regional culture and architecture is connected with very strong and characteristic architectural stylistic elements and should be continued.
(3) Changing the places into contemporary time architecture, must takes into account strength requirements, durability, ergonomic, safety for habitants, functional and technical aspects.
(4) The village Kemer should be a zone of special landscape and architectural protection as a cultural heritage of Turkey to prevent further technical degradation of the buildings. But probably there is not a chance to save life as it was before in these historical place.

The closure, isolated space, which is generally criticized, mainly in the context of closed housing estates, turned out to be symbolic and inspiring for architectural research, dominated the thinking about the housing architecture and made it possible to discover the additional advantages of residential architecture in the region. The courtyard creates a buffer, an intermediate space between the house interior and exterior space, and is in contrast to the contemporary mono bloc houses commonly designed in Europe. Open houses with a particular focus on the visual attraction and compact character of the building are designed here. There are no architectural elements integrated into the building's structure, there are no compilations of solids that would complement the space to create additional living space, fencing elements are not designed as a continuum of the house's form but are randomly selected from manufacturers' catalogues. Gardens in architectural project are mostly opened and visible from street what is not comfortable for inhabitants. The aspects of possible implementation space solutions and natural environment of courtyard connected and integrated to the house from Turkish tradition to projects in Europe are also should be inspiriting for modern architects.

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Identifying Best Practices for the Construction of Residential Basements in Fargo, North Dakota, USA Using Building Information Modeling (BIM)

Abdul-Aziz Banawi(✉), Cyril Ahiable, Zhili Gao, and Bi Bin

Department of Construction Management, North Dakota State University, Fargo, ND, USA
{abdulaziz.banawi,cyril.ahiable,jerry.gao,bin.bi}@ndsu.edu

Abstract. This study aimed to evaluate and improve the construction processes for basements in Fargo, North Dakota. Basement construction was scrutinized in this study as a small but vital aspect of the many processes that go into building many homes in Fargo. A typical residential basement was analyzed to identify critical areas that could be improved in the construction process. An interactive BIM model of an as-built home in Fargo was developed for quantitative analysis. Face to face interviews and surveys with local contractors and home owners were conducted to ascertain their views and register complaints and suggestions on current standard practices in basement construction. The completed model displays hotspots within current construction practices, recommends appropriate measures for common basement issues during and after construction as well as suggest parameters designers and planners can use to make informed decisions on basement construction.

Keywords: Building Information Modelling · Basements · Construction · Fargo

1 Introduction

As we strive for improved living standards in the form of good infrastructure, cutting edge technology, improved housing etc., there are corresponding downsides especially with respect to the environment. As economies of countries grow, the built environment is one sector that almost always experiences a corresponding boost in activities. The increase in construction activities more often than not directly impacts the natural environment adversely [1]. There have been numerous reports on the negative effects of construction on the environment so much so that, it is safe to classify this issue as common knowledge.

According to the World Bank report in 2012, solid waste generated globally averages 1.3 billion tons per year and half of this volume is said to be contributed by construction activities including material production, construction, and demolition works [2]. In the United States alone, total construction and demolition (C&D) waste

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was estimated to be 569 million tons in 2017 [3]. In addition to the immense waste generated by construction, the growing complexity of projects throughout the years has raised the demand for better methods of project delivery [4]. Architectural, Engineering, and Construction (AEC) professionals keep pushing the boundaries of innovation in the building industry. The combined demand for leaner (less waste) construction and better ways of achieving complex design feats in construction has led people to gravitate a lot more towards Building Information Modelling (BIM). BIM, contrary to popular opinion, is not exactly 'a tool'. It can rather be more accurately defined as an intelligent interactive multi-dimensional model-based **process** that affords AEC professionals the ability to plan, design, construct, and manage projects more efficiently. BIM presents an invaluable opportunity for AEC professionals to integrate roles and deliver projects collectively in an efficient manner [5]. This study aims to take a cue from this and apply BIM in the improvement of construction processes. Creating a collection of best practices for construction processes will enable stakeholders improve on their methods which will in turn bring a corresponding improvement on prevailing issues in construction.

1.1 Construction Best Practices

The Construction Industry is one that can do with a lot of improvement relative to manufacturing industries [6]. This study embarked on a process to collect information from various sources that would aid in improving overall efficiency in construction and environmental impact. There are many ways to approach a job in the field. It is usually the ones who have performed the job time and time again that possess the ability to discern and decide on which methods are best suited for both common and unique situations. Information from research papers, surveys, as well as expert opinions and recommendations from AEC professionals was sought. This was crucial in attaining the most appropriate methods and practices within the construction process. Structural, safety, cost, efficiency and ease of application were some of the major areas considered for scrutiny with each construction process. For the case study, residential building construction was selected. Basement construction in Fargo was a subset within the residential construction process that was given priority as a small part of an extensive research. The goal of representing data from this study in a BIM model was to create an innovative method of data assessment and dissemination.

1.2 Why Basement Construction and Fargo?

Basements have long been a design feature in many buildings and they provide storage space for utility or in some cases, an extra living space. The basement of a residential building was prioritized for this study because, basements are usually costly and possess high embodied energies. The reason why basements are capital and energy intensive is because they are primarily made up of retaining walls - a foundation structure. Construction of various foundation structures consumes a large amount construction material [7]. This could be translated to a high embodied energy [8]. Analyzing and improving this aspect of construction will have significant upturns in building performance and construction processes making this a good area to start investigating.

Fargo, North Dakota was selected based on a few factors. To begin with, many residential homes within the town had basements. Surveys distributed to home owners further asserted this claim. The climate in the region was another compelling factor. Winter in Fargo presents some of the harshest conditions for construction and to be able to deliver projects successfully, barring all the challenges, is a feat to be studied and lauded. Basically, the best construction practices within the harsh climatic conditions is a good point to start. In addition, Fargo is also a relatively developing city in a state that is experienced a relatively recent economic boom. The U.S. Census Bureau published in 2018 that housing growth in North Dakota is the fastest growing in the nation at 18.9% [9]. Economic development and expansion is almost certainly accompanied by increased construction activities in order to accommodate the growth in population and transactions [10]. Assessing how things are done in a relatively developing state presents the opportunity to improve current methods so as to begin a trend/culture of good construction practices. This will aid in reducing the adverse effects construction has on the environment.

2 Methodology

This study was conducted in two phases - Data collection and analyses and BIM Model Development. Close ended surveys and one-on-one interviews were adopted as the data collection methods to gather general responses on issues concerning basement ownership and construction respectively. In-person interviews were conducted with some local contractors for details on recommended methods and practices for basement

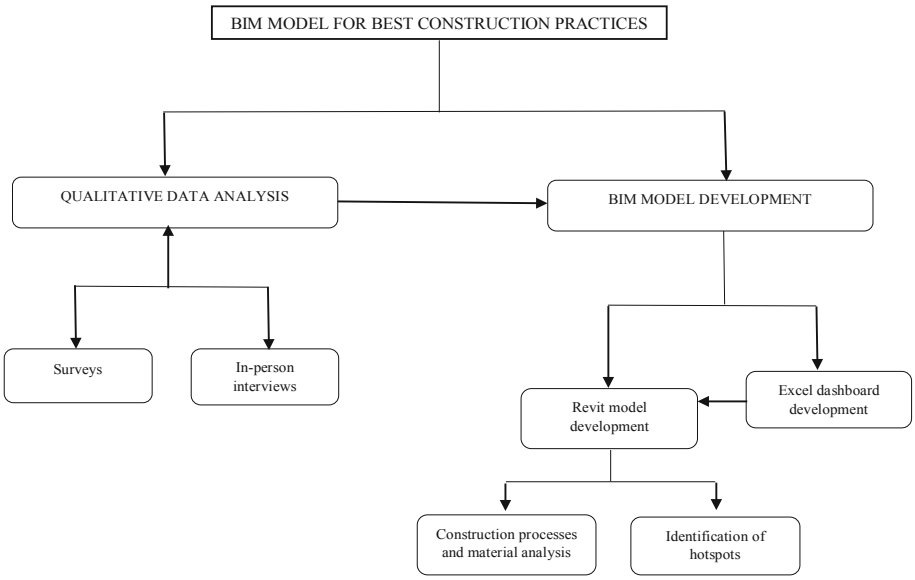

Fig. 1. Schematic representation of research methodology.

construction. With the available data, an interactive model was developed in Revit and infused with suggestions/recommendations of the best practices for each subject discussed under basement construction. The discussed subjects include but not limited to, excavation, insulation, safety, and cost of construction. With this model, users will be informed on suitable methods and parameters to consider when constructing basements. The following figure is a schematic representation of the research process (Fig. 1).

3 Results and Discussion

The results of this study can be divided into two parts; Surveys and interviews data and BIM model Outputs

3.1 The Surveys Results

The survey questions were designed to collect information on the state of residential basements in Fargo and the problems owners face with owning basements. The questions in the surveys were in two forms. The first type of questions was to gain enough information to develop a BIM model that represents the majority of residential basements in Fargo. The second type of questions were useful in knowing the common issues with basements in order to address the right problems. The following table summarizes results from both home owner's and contractor surveys. Statements ending with '(H)' and '(C)' represent specific questions and responses in home owners' and contractors' surveys respectively. The results from the surveys were used as a guide in developing a model that best represents a typical basement in Fargo. They also gave an indication on the hotspots/problem areas associated with basements for in depth consideration (Table 1).

Table 1. Summary of survey results from home owners and contractors

Question	Questions in the survey designed for:		Majority response	Percentage
	Homeowner (H)	Contractor (C)		
What type of basement do you own?	✓		Finished-full basement	50%
What type of basement projects have you been involved in?		✓	Finished-partial basement	100%
Per your estimation, what is the average percentage share of basement construction cost compared to the entire home construction cost?	✓	✓	10%–20%	68.8%

(*continued*)

Table 1. (*continued*)

Question	Questions in the survey designed for:		Majority response	Percentage
	Homeowner (H)	Contractor (C)		
Which process would you select as the most cost intensive for basement construction?		✓	Concrete works	75%
What is the main use of your basement?	✓		Storage space	60%
What aspects of the basement significantly impacts your energy consumption?	✓	✓	Ventilation, heating & lighting	55%
Which problems have you encountered in your basement?	✓		Cracks in walls/slabs and humidity/molds	71.4%
Which of these are common issues with basements you have dealt with?		✓	Humidity/molds	75%
Which of these is your choice of insulation for your basement?	✓		Water proof paint	36.8%
Which of these is your most preferred choice of basement insulation?		✓	Spray foam	75%

The above results are an indication of basements being a common feature in many homes in Fargo. All home owners however reported having at least one problem with their basement with the dominant issue being the occurrence of cracks and molds.

3.2 The BIM Model Outputs

The BIM model was developed for two main goals; to **Analyze** and **Inform.** Throughout the study, various aspects were considered including structural integrity, cost and embodied energies, excavation, insulation, safety and drainage. One finding imputed into the BIM model was frost line depth information. In a place like Fargo-ND, the frost line depth is a parameter that needs consideration due to its effect on basements during and after construction. The presence of frost in the ground can pose challenges and affect construction quality through a phenomenon called frost-heaving. Frost heaving is the upwards swelling of soil in freezing temperatures and this upward movement can displace foundation structures causing cracks. Considering the survey results from home owners on basement problems, frost heaving could be the cause of some occurrences of cracks in basements. One way to guard against the effects of frost

heaving is to extend footings below the frostline. The average frost depth in Fargo ranges between 15 in. to 24 in. It can however increase to as much as 3 ft in the peak of winter. To this regard, Frost line depth information is provided in the model in order to inform users on the appropriate depths to excavate. The model was infused with other important information of this nature to guide users in the planning and decision-making process. Locally sourced information of this sort makes a difference in planning and construction and reduce potential unforeseen risks on the ground.

4 Conclusion

Basement construction involves many crucial components of the entire building process and must be regarded as much as the other building stages. It may be a relatively simpler process but it can be problematic in the long run if not done right. Collating practices to improve the construction process is a step in enhancing the efficiency and quality of construction. This study was developed with the aim of equipping stakeholders with the needed information to deliver basement construction projects more efficiently. With reference to winter conditions for instance, it is important to know how the dynamics of construction processes change and adapt accordingly. This study has enormous potential and can be developed to encompass all the different elements and stages involved in a complete building process. The information shared in this study is from a collection of opinions and recommendations from experts in the building industry. They are by no means meant to replace scientific values and are intended to offer the needed guide for achieving best basement construction practices. Future studies can be in probing into other building processes and updating the current model with the associated data.

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The Contribution of the Built Environment to the Success of Learning: The Role of Colour in the Ergonomics of Educational Spaces

Denise Gaudiot(✉) and João Pernão

Faculdade de Arquitetura, CIAUD, Universidade de Lisboa, Rua Sá Nogueira, Pólo Universitário, Alto da Ajuda, 1349-063 Lisbon, Portugal
dg.arquitetura0@gmail.com, joaopernao@gmail.com

Abstract. Within the process of environmental perception, the importance and interference of colours in the formation of *stimuli*, cognitive development, creativity and psychological comfort are clear. Vision accounts for more than 80% of the information gathered in the perception process. Colour is a fundamental attribute in this process, influencing the user's emotional relationship with the environment and consequently his well-being. The choice of colours should contemplate aesthetic, psychological and cultural attributes without neglecting the elements that determine the visual comfort, such as contrasts and the possible harmful effect of gloss. All of these elements can alter the perception of space. This paper aims to analyse the importance of the use of colours to aid cognitive development inside educational spaces in support for the ergonomics of the built environment. In these spaces, the colour palette should be measured according to tangible evidence, never neglecting beauty criteria.

Keywords: Learning · Built environment · Ergonomics · Colour · Perception

1 Introduction

One of the first social activities performed by the human being is the learning process. The adaptation of the environment in which this activity occurs led to the creation of specific enclosures for the development of learning: classrooms.

Considering that the use of space is one of architecture's main functions, the classroom is the essence of the school project's program since it is the heart of socialization, knowledge and educational philosophy of each academic centre. Moreover, for healthy development, students need physical-environmental diversity that allows for different learning opportunities as well as social interaction.

Whereas ergonomics studies the relationship between users (students and teachers), tasks (teaching and learning), objects (furniture) and space, the project process for an educational centre should lead by the ergonomics issues imposed on it.

According to Falcão [1], environmental ergonomics, also called ergonomics of the built environment, is concerned with how people feel the environment, based on psychological, social, cultural and organizational aspects.

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However, a large portion of institutions has been concerned about their pedagogical programs success while paying little attention to the physical environment of their facilities. Researchers and school architects often wonder if it is necessary for the student to adapt to the learning environment or if is the environment that should suit the student. For Lippman [2] the important is to question the interactions between students and their environment and to determine how the environment shapes students and is influenced by them.

Spatial interactions generates the information employed by users and is responsible for the space definitions during the architectural project process. Human senses perceives and captures details through the attention stimulated from the environment.

Within an educational space the chromatic design, as an element of the built environment ergonomics, can create functional zoning, hierarchize functions and highlight elements strategically positioned to serve as references.

Determining the better willingness of the environment's elements colours can contribute to improve the teaching-learning process. The force of attraction conferred by the chromatic contrasts that hierarchize and highlight information, have a positive influence on the state of attention.

Chromatic information should be part of the ergonomic design of the environment since it is an important informational strategy and reaches users through necessary data provided by its dynamic or stable elements.

2 Ergonomics of the Built Environment

The ergonomics of the built environment acts on the object of study determining the necessary requirements for the environment adequacy to users, as well as ensuring its overall performance [3].

The idea that ergonomics aimed to correct situations that present dysfunctions prevailed for a long time. Nevertheless, its function should not be restricted to fixing work problems or related to the environment. It should be part of the project design, therefore avoiding future problems.

It is essential that spaces and organizations form a total and integrated system, because without this guideline, no physical structure will provide comfort to their users. Regulatory standards can previously established some parameters, proposing basic environmental conditions to obtain comfort in performing activities by default [4].

According to Montmollin [5], a discipline close to ergonomics is pedagogy. He states that didactic seek to know how students learn in order to improve training devices and design appropriate teaching techniques for the cognition process. The mechanisms of understanding and learning are objects of research in didactics. Ergonomics provides tools to comply with the dimension of teaching-learning situations by pointing out how information can be transmitted among the individuals involved.

For instance the dimensioning of spaces, as well as their materials, shapes, coatings, colours and illumination, should not be defined only depending on the furniture and equipment, but mainly according to users and activities, pedagogical or not, to be developed in that environment.

In the case of a school environment, the analysis of the activities developed there, teaching and learning, is the starting point for the definitions of environmental comfort, layout, displacements, safety and exchange of information.

Architectural elements can function as learning stimulators but they can also generate barriers and obstacles preventing inclusion and accessibility. To identify these elements a systematic observation of the user-environment-task process is required.

The use of colour can be of great value to highlight, disguise or integrate those elements, visually, to their surroundings when those obstacles cannot be removed. Pernão [6] considers that;

> "In addition to the ergonomics issues already addressed and of particular importance in long-term environments, there is a fundamental issue for the work effectiveness and comfort of the users which is the balance between unity and complexity in its surroundings. An achromatic ambience with constant lighting can produce, through its monotony, a lack of stimulus that will impair concentration. On the contrary too stimulating chromatic ambience can also disturb for opposite reasons - excessive stimulus - concentration at work and may cause an increase in heart rate, pulse and respiratory rhythm."

Thus, the professional should design a project from the principles of accessibility and inclusion considering ergonomics of the built environment and their relation to perception and physical space. This will prevent against future adjustments.

2.1 Colour and Environmental Perception

Environmental perception, among other aspects, studies systems where sensory aspects prevail (perception and treatment of information) and decisiveness This involves the process of collecting information (perception), storage (memory) and its use at work (decision), which translates into the study of the cognitive aspects of man.

> "Environmental perception is a process that has as starting point the interaction between the space and the user. In this continuous interaction, there is a dynamic process whose exchange of information establishes an active relationship. Receiving and transmitting that dynamism continuously fuels this process [7]."

It is by the environmental information perception that the individual will develop the image (mental map) of the space where he is situated and act. Therefore, man's actions in a space can be by understanding and accepting it, as well as denial, and this will induce the adequacies of both agents that aim at their good relationship.

This information is organized and placed in a hierarchical form according to the chromatic space generated by colour manipulation. This space has the sense of helping understand the role of colour in spatial direction information. Thus, familiarity helps understand chromatic information in the ambient itself.

"Technically the word 'colour' is employed to refer to the conscious sensation of a person, whose retina is stimulated by radiant energy." Farina [8].

According to author the physical capacity of each individual, it is possible that colour's capture is different. This capture occurs through one's vision, which "[…] represents one of the gems that man received from nature. It is perhaps the sense that makes the human being vibrate the most and makes him think, enjoy and enjoy the things of the world around him".

On the other hand, the object needs luminosity to reflect and transmit the sensations provided by each colour. The vision captures the colour and transforms it into sensations that will be responsible for its assimilation.

However, perception despite occurring similarly among people can vary according to the physical and sensory limitations of each individual.

An environment that is not prepared to meet the inputs diversity that passes through may presents obstacles to the users' individual characteristics. Even though it is not possible to contemplate every individuality, the more standards are contemplate, the more accessible, comfortable and safe the space will become.

2.2 Colour and Educational Spaces

Colours act as codes to be deciphered by the brain in order to organize images for our visual perception. According to Pernão [6]:

> "When choosing a colour through a sample we should not ask if it is beautiful or not, but if it will meet the required aesthetic, ergonomic and programmatic assumptions. In other words if it will have a correct application on the specific surface to which it is applied, whereupon it inevitably will have a certain texture, with a certain level of brightness, occupying a certain position in space, with a specific dimension, with a visual relationship with other colours, and illuminated in a certain way."

Likewise, to make the environment livelier or easier to focus, colours are used. By itself, colour will not have the power to make a person change his mood, but it will rather facilitate that change.

Engelbrecht [9] considers that in this way the use of colour in certain situations and environments - as is the case with educational spaces - is coated with expectations regarding the promotion of cognitive stimulation and the use of contrasts and of a more saturated colour palette, understood as a mere decorative element, is often rejected. In this case, the chromatic project should have a dual function. One to satisfy the needs of visual comfort, and the other for a sense of belonging and assists learning.

The sense of belonging conveys the feelings of familiarity and tranquillity necessary for learning. Farina [8] affirms: "About the individual who receives visual communication, colour exerts a threefold action: to impress, to express and to build. The colour is seen (impresses the retina), felt (provokes an emotion) and it is constructive because, having a meaning of its own, has symbol and ability. Therefore, to construct a language of its own that communicates".

Considering classrooms, it is important that the use of colour be more functional than aesthetic to achieve increased concentration and reduce eye fatigue. Tangible evidences should measure the schemes used in a space and not just beauty criteria.

Using colour in a school environment can reduce visual fatigue and increase student concentration. People who remain in monotonous environments can be led to feeling tired, boredom and have difficulty to concentrate.

Nevertheless several authors, among them Pernão [6], consider that colours like blue and yellow, when used in a pedagogical environment, should be studied in such a way that their application does not overlap with space and stand out differently from the

desired effect. These colours are perceived by peripheral vision, and are quickly detected through the eye. That being said the tones should be softer, and not aggressive.

From our perception, warm tones stimulate and increase brain activity, generating excitement, whereas cool tones promote relaxation and internalization. These properties need to be competently managed in the educational universe since there is no doubt about the power of colours to instigate the visual sense and, therefore, encourage retention of information.

According to Farina [8], Pedrosa [10] and Gaines and Curry [11] some recommendations on the use of colour in classrooms are pertinent, such as:

1) Strong or primary colours should be avoided in the main wall; however, soft colours, such as green or shades of blue, can be used in other areas of the classroom.
2) A warm neutral colour scheme such as sand shades, for example, would be a desirable basis.
3) The main wall (where the board is) being where students focus during classes should have a medium shade within the chosen colour range.

As for colours the recommendations are:

Green: colour that transmits peacefulness and relaxation necessary for learning. It should be especially used in various shades, as occurs in nature. In Pedrosa's view [10] "because of the infinite range of its components (blue and yellow) and the wide range of saturation and clarity it has, green meets the best conditions for interior decoration".

Blue: also widely used in school environments, the lighter shades of blue can calm and help students with specific hyperactivity problems. It can also reduce the number of outbreaks of misbehaviour and disciplinary problems by facilitating classroom control with creative management. It is the colour of water and sea, conveying the feeling of ordinary life. Farina [8] states that it is the colour of the eternal, the infinite and the sky and represents intelligence, recollection, peace and security.

Orange: colour that represents creativity, luminosity and extroversion. Being lively and energetic is associated with child activity. It is a great choice for school spaces, but should be used sparingly. Farina [8] comments that orange is in a middle ground in the sensations transmitted by yellow and red, and the sensation that most closely resembles the colour orange is that of transformation.

Yellow: colour that stimulates the nervous system towards optimism represents energy, intelligence and expansiveness. It is one of the most radiant in the spectrum. It drives the action. According to Farina [8] "yellow refers to joy, spontaneity, action, power, dynamism, impulsiveness" and "may also suggest empowerment, stimulation, contrast, irritation and cowardice".

Grey: monotonous, sober and neutral, the colour grey needs to be well dosed in the educational environment. In architecture, can behave in an elegant manner and raise the level of formality, and may be more suitable for adult education centres.

However, these recommendations are somehow abstract, and the characteristics and uniqueness of each space, such as its shape, volume and illumination, must be understood in order to use colour wisely. Different levels of colour presence in space should be taken in account: dominant colour (main area), sub-dominant colours (minor areas) and accentuations (details). A single requirement cannot define the use of a colour. The choice must always be associated with its immediate relationship to the

materials, light, whether natural or artificial, and brightness's well as the contrasts between different shades or hues.

3 Conclusion

Representing an extremely complex organization, the architectural project of the school environment requires careful consideration, as it must provide the right conditions for all actors to be welcomed and at the same time feel challenged by the proposed activities.

For this purpose, colours are a resource of the utmost significance. If, on one hand, they must sustain a welcoming ambiance, on the other they should not induce astonishment nor monotony. The search for balance has to be guided by compositions designed especially for each school and for each of its allocations.

A language that not only represents the image of reality, but also generates signals with their own meanings, express colours. Environments created by colour can cause different impressions ranging from calm and joy to anger and despair.

Each colour, with its hues and shades, expresses a meaning and provokes reaction and emotion. It can communicate an idea or a sense of awakening. Our body interpreters and reacts to certain colours creating physical and emotional reactions such as blood pressure, eye fatigue, brain development and sense of power among others.

As we have seen, functional aspects, not just aesthetics, should guide the choice of colours for educational environments. Too colourful environments can cause information overload, just as monochrome ones can lead to monotony and stress.

Thus, it can be stated that, besides the aesthetic level, colour influences the teaching-learning process within an educational space. The chromatic project assumes an ergonomic role that enriches the school architecture in a functional way under different aspects: physical, cognitive and psychological.

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Students' Approach to Recycling and Sustainability: A Design Study on Affordable Container Houses

Salih Ceylan(✉)

Department of Architecture, Faculty of Architecture and Design, Bahçeşehir University, North Campus, Ihlamur Yıldız Street No:10, Bl: B Fl: 8, Istanbul, Turkey
salih.ceylan@arc.bau.edu.tr

Abstract. The world has been suffering from serious environmental problems in the last decades. However, there are also ongoing attempts to reduce harmful human impact on nature. All those attempts require interdisciplinary work by various professions, one of them being architecture regarding its role and responsibility in environmental issues. Architecture discipline is required to formulate new methods and strategies to maintain harmony between natural and built environments. Furthermore, the academy in the field of architecture has the mission of training future architects with the notion to meet the expectations of contemporary societies. Accordingly, sustainable design and energy efficiency in buildings have become important fields in architectural education.

This paper presents container housing as an educational theme in the design studio for first-year architecture students as a reliable method for environmentally responsive design. The findings of the case study point out that using a design topic that promotes sustainability and energy efficiency has a significant effect on the students' awareness about the issues.

Keywords: Architectural design · Sustainable design · Energy efficiency · Architectural education

1 Introduction

The world is going through an intensive process of change in terms of ecological and environmental awareness. However, according to UNDP, the last four years have been the warmest in recorded history, and greenhouse gas emissions from human activities are still rising [1]. This means existing methods of growth and development are not enough to stop the environmental problems so that new strategies have to be employed to achieve sustainability of nature and society. For this reason, United Nations Development Programme (UNDP) started the Sustainable Development Goals consisting of 17 goals from a wide range of topics such as sustainable cities and communities, decent work and economic growth, and quality education [2]. To meet these goals, effective endeavor and dedication are needed from different disciplines and practices.

Buildings and construction industry combined are responsible for 36% of global final energy consumption and nearly 40% of total direct and indirect CO2 emissions [3].

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In this regard, the discipline of architecture is required to integrate various strategies about environmental, social and economic sustainability into the design and construction process to meet the needs to prevent expected climate alterations and environmental pollution. Architects are concerned about the development of the built environment and the practice of architecture is responsible for the way the built environment is designed and planned. UIA declares its dedication to and engagement in UNDP's Sustainable Development Goals Programme by forming a commission holding the responsibility to achieve the objectives of the program [4]. Various investigations to reduce the energy consumption of buildings to provide environmental sustainability of the built environment is going on both in professional and academic stages of architecture. The academic environment holds great importance in terms of environmental sustainability, as numerous studies are being conducted to compose new methods of design and construction that enable efficient use of energy in buildings. Another important mission of the academic environment derives from the fact that it is the place where future architects are being trained with the notion to meet the expectations and requirements of contemporary society for socially, environmentally and economically sustainable human settlements.

2 Higher Education and Environmental Sustainability

Education is a powerful agent of social change for it raises awareness of new developments and provides training for professionals and researchers who will develop the next generation of systems and devices [5]. Education in the field of architecture has a great responsibility in the training of young architects who are aware of the rising environmental problems and capable of providing proper solutions for those problems. The role of higher education as a means of comprehensively introducing new generations of architects to the principles and practices of sustainable environmental design is becoming highly significant [6]. Sustainable design and energy efficiency in buildings have become major subjects at schools of architecture for many years. UIA and UNESCO include environmental sustainability as a teaching requirement in the validation system for study programs as follows:

- Awareness of responsibilities toward human, social, cultural, urban, architectural, and environmental values, as well as architectural heritage
- Adequate knowledge of the means of achieving ecologically sustainable design and environmental conservation and rehabilitation [7]

Sustainability issues receive significant interest from architecture schools as well. The reflections of the awareness on sustainability problems are to be seen in different institutions' statements. Pratt Institute's updated strategic plan is based on the fast-growing impact of human beings on the natural environment, offers a collaborative, interdisciplinary, solutions-based education [8]. The mission statement of Technical University Munich emphasizes the sensitivity towards the global challenges of an urbanized world as well as towards the value of our cultural and natural environment [9]. Many other examples of the emphasis on sustainability issues can be seen in different institutions. Despite the use of different vocabulary such as green architecture,

climate responsive design, bioclimatic architecture, net-zero energy building design, etc., the aim of attaining environmentally sustainable design is being emphasized firmly in recent years at various stages of prominent architectural education institutions.

Despite all the advancements, the current progress of the integration of sustainability into architectural education is still under development caused by certain restrictions. Firstly, the approach is not enough recognized and implemented around the globe yet. Although prominent architecture schools in developed countries deal with sustainability issues at an advanced level, institutions from different regions either do not recognize sustainability as a primary problem in architectural design or tackle the issue only partially and superficially. Secondly, there is a large gap between the existing and required numbers of trained academic personnel in the field of sustainability in architectural education institutions. Thirdly, sustainability in architecture is a recent field of work that needs economic and technical support, but it is not easy to get such a large amount of financial contributions for facilities like building physics and environmental technology laboratories. Consequently, these restrictions and other conditions enforce educators to look for alternative methods to integrate sustainability into architectural education.

3 Container Housing as an Educational Theme

For better integration of sustainability into architectural education, various applications can be implemented into different phases of the curriculum. Theoretical, as well as laboratory-based, compulsory and elective courses, are suitable for the implementation. Alongside other courses, the architectural design studio is the most suitable environment for implementation of sustainability into architectural education because it is the core of it and the place where every gathered knowledge from other courses and lectures becomes a resource for design. Today, the design studio is not only a classroom but also a research lab [10]. Every suitable topic can be a theme for the design studio exemplified as conservation, urban design, or sustainability. Especially in the first-year design studio courses, the topics of the design show a great variety like small structures [11], socialization spaces [12], or flexible architecture [13]. Among the others, container housing can be utilized as a design subject for first-year architecture students. The factors that make container housing a suitable subject for first-year design studies intensify on 3 main points. Firstly, containers are familiar objects for every person as they exist in different locations being used with different purposes in any urban area, especially in waterfront cities. Secondly, the size, proportions, and shape of a container are very appropriate for a first-year architecture student to work on. The total useful volume of the container matches well with the required space of a one- or two-person living unit. There are many examples around the world the students can inspire from, where the containers are being used as living units for small families. Thirdly, using containers as housing units contributes to sustainability significantly as an obvious example of recycling. For first-year students, it is important to familiarize themselves with definitions connected to sustainability like affordability and upcycling. Raising awareness on these issues may also support the students with their ongoing education and future career for becoming able to come up with environmentally responsive design solutions.

3.1 Containers as Housing Units

The economic recession period in the world led to a significant reduction in the exchange of goods by sea, which ended up with an increase in the accumulation of shipping containers at ports [14]. Therefore, making use of them by giving new functions such as habitation units was considered a good way of efficient use of existing resources. Additionally, containers are designed to shelter goods throughout their journey on the oceans, so that they need to be structurally firm and resistant to aggressive climate conditions for long periods [15]. Their firmness, size, and geometric characteristics, in addition to their low-cost character, allow them to be employed as suitable units for habitation. Currently, many examples of containers used as habitation units can be found anywhere on the globe [16].

Looking at a shipping container, the main and basic conditions of a space can be perceived, and with some modifications it can host various human activities, creating functional and interesting spaces for people to live in [17]. They hold a lot of additional advantages for being used as housing units. The first of them is the affordability as used shipping containers are easy-to-find and low-cost products. Another advantage is their modularity and suitability for modular expansions. Even a whole neighborhood can be created through the reproduction of the same unit. Additionally, the short time to construct container houses is also advantageous in terms of construction management. All the aforementioned factors also enable container housing to be a proper exercise subject for students of architecture, as observed in the case study in the scope of this paper.

4 The Studio Experience

Based on an assessment of the needs of industry and society, several new approaches to energy efficiency in education have been introduced in the past decades [18]. This paper presents a similar attempt to integrate energy efficiency and sustainability issues into architectural education through a case study conducted in the design studio for first-year students. General characteristics of shipping containers, their potential to create different uses and their suitability for establishing communities [19] have been the main motivations in the formulation of the case study.

The studio work consisted of a 5-week long design exercise involving container housing where students had to work personally, as well as in small groups. Group work was about the planning of the site using containers as units to populate the area, as personal performances comprised of the design of a single container unit as a house for a couple of people. Both works needed to start and develop simultaneously, as they depend on each other regarding the main design decisions.

The first week of the work started with the site visit to the project site which was on a lakeshore with slightly sloped topography in the outskirts of Istanbul, the biggest city of Turkey with a population of 16 million people. During the site visit, students got familiar with the needs of the area and started to create their scenarios about the user profile of the container houses. At the same time, they decided about their working groups to begin discussing how the container houses were supposed to come together and what kind of relationship they needed to create between each other to form a

healthy neighborhood in the given site. Following the site visit, the students were introduced into the concept of container housing with a lecture. In the lecture, the rules about the assignment were declared to the students and discussed in groups for a better understanding.

4.1 Design Rules

Providing integrity of the students' design is an important objective in a design studio course. Therefore some rules were set regarding the design of the container houses. The rules were gathered around the two parts of the assignment, site planning, and unit design. For site planning, the three rules were as follows:

- Every unit needs at least 50 m^2 of private open space use.
- Each container unit needs to be at least 5 m away from the neighbors.
- The natural topography of the site needs to be used. Significant digging into the ground and escalating to higher levels are not allowed. Therefore every unit needs to be accessible from the ground level.

For the design of the container unit as a living space, the following rules were set:

- Only a single container unit with the dimensions 605 cm × 245 cm × 245 cm can be used as the main body of living space for two people.
- Every necessary part of living space such as the bathroom, kitchen, living room, bedroom and study area must exist within the given closed space.
- To protect the character of the container house, only a small amount of extra material or elements, up to 10% of the given space is allowed to be used.
- The zero-waste principle is embraced in the design. Students need to reuse the parts they removed from container surfaces for wall or roof openings on different locations such as partition walls, decks or patios.

Especially the last two were debated thoroughly in detail among the class to reach a consensus among the students. After every point had been clarified, the students started to work on their site analyses and design proposals.

4.2 Final Proposals

Throughout the period of 5 weeks, the students kept developing their design ideas, personally for single units and in groups for the site planning of the neighborhood. At the end of the schedule, the works were exhibited and evaluated by the instructors of the studio together with other professional architects. The main evaluation criteria of design focused on functional requirements, resource management, and visual representation. Besides the basic requirements, students' general attitude against the design of container housing units highlighted the following approaches:

Flexible Use of Interior Space. Due to the limited space in the interiors, students tried to come up with the best design solutions by using convertible furniture such as retractable desks, dinner tables that can be used as kitchen counters, bunk beds or studio couches.

Some of the students attempted to use the increased height of the container by elevating the roof from one or two sides. Increasing and using the full height aided them to create a mezzanine floor for bedroom or closets for storage.

Outdoor Use. Even though the interior space was needed to be functional to allow the users to fully perform their daily activities, site analysis and the location of the container housing encouraged the students to make efficient use of the exterior space as well. Most of them attempted to create a strong relationship between the living spaces in the inside and seating areas in the outside by creating transparency and semi-open spaces that are protected from rain and sun with shading elements. Some students made use of the flat roofs of their containers to catch the view of the lake. Thus they created extra usable space with a desirable vista for the inhabitants. Some other students wanted to have a direct physical connection with the water, so they placed the container houses near, or even partially on the shoreline.

Sustainability Issues. Students' approach to sustainability showed a great variety. Most of them employed passive strategies for energy efficiency by making use of natural daylight, orienting the building according to climate conditions, and locating wall openings based on the concerns about passive ventilation. They concentrated on water, waste and resource management through recycling household waste, reusing rainwater and planting their vegetation in their gardens. Some of the students attempted to produce energy from alternative sources like sun, wind or water.

5 Conclusion

The results obtained from the design studio approved that container house design is a suitable subject for raising awareness of sustainability and recycling issues among students of architecture. The decision of using containers as housing units provoked the attention of the students towards sustainability and energy efficiency issues. Based on the experience in this paper, one can assume that further studies on container housing provide many benefits for architectural design education.

Besides the awareness of sustainability issues in architecture, the experience has been beneficial for the students from different aspects as well. Firstly, they understood that beautiful, healthy and comfortable buildings that also have a limited impact on the environment can exist [20]. They found out that through a comprehensive design and efficient use small spaces can become desirable living environments. They have learned the importance of affordable housing for the society, and their thoughts about residential areas have changed according to their experience in container housing design.

Consequently, it can be asserted that design studios are important places where students get introduced to important architectural concepts like sustainability. However, sustainability necessitates a restructured academic curriculum, technically and socially alert professionals [21]. For a better implementation of its implementation into architectural education, a holistic approach is needed.

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Ergonomics in Urban Design

The Study on Adaptation of Vernacular Architecture in Modern Rural Architecture Design During the Process of Rural Revitalization

Mo Zhou[1(✉)], Wojciech Bonenberg[1], Xia Wei[1], and Ling Qi[2]

[1] Faculty of Architecture, Poznan University of Technology, Poznan, Poland
{mo.zhou,wojciech.bonenberg}@put.poznan.pl
[2] School of Architecture and Urban Planning, Beijing University of Technology, Pingleyuan 100, Chaoyang District, Beijing, China

Abstract. Vernacular architecture has been keeping growing along with continuities transformations and adaptations to the different socioeconomic development and climate conditions based upon local needs in different periods of time. How to preserve the tradition during the modern rural construction has been concerned by many architects and local inhabitants already. In the process of rural revitalization, the adaption of vernacular architecture has a deep impact on the modern design of residential housing and public buildings. In the study of the adaptation, it is also worked as the form of an attempt to revoking tradition and vernacular into modern design during the rural revitalization. The study will be clarified from the case study with the traditional villages in China and in Poland respectively. The factors mainly were considered in the study as below: the inheritance of traditional culture, introducing green building technology, using local materials, considering the local microclimate, increasing the inclusiveness and versatility of the buildings in rural areas. In general, It highly recommended combining harmonious development inheriting the traditional vernacular architecture as well as combining the environmental characteristics and construction features into the modern architecture design.

Keywords: Vernacular architecture · Adaptation · Rural architecture · Tradition · Locality

1 Introduction

This Vernacular architecture is a living organism that grows over time and it cannot be put on ice during conservation. It has been changed and transformed according to the social and economic conditions of each era and it has been adapted to the different conditions of each period of culture as long as it continues. Consequently both the continuities and the discontinuities are essential parts of the life and making the big progress through time [1].

The architecture of traditional settlements has been a living and invaluable testimony to the historic memory of each place. Polish rural areas is undergoing serious

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socio-economic transitions in recent years. Due to the big movement migration of population to big cities from the countryside, or even abroad lead to an increasing number of abandoned homesteads. The farmlands are being consolidated by big land owners and unnecessary structures are being demolished [2].

Architecture, particular vernacular Architecture, as a complex of the inhabitants vibrant manifestation to express how identity and sustainability are in accordance with nature, surrounding environment and culture.

Traditional architecture in collusion with nature creates a balanced and environmental lifestyle and also emphasize on the local climatic and topographical characteristic. It represents a response to natural surroundings of locality where architecture emerges. However, it is necessary to have a critical attitude towards tradition and what makes the tradition. Such a thoughtful approach should be related to the modern architecture, where the adaption of traditional architectural elements should be the result of analysis, and even critical attitude towards tradition and ancestral architecture [3].

China's rural hollowing has been accelerated due to the rapid industrialization and urbanization under urban–rural dual structure since the mid-1990s Constructing a sustainable rural tourism-based traditional village revitalization model offers a better understanding of the relationship between local residents and village revitalization within a rural tourism context. Integrated Rural Tourism must be better interpreted and applied [4].

With the point of natural environment adaptability based on the village layout, In the process of rural revitalization in many regions of China, conservation was carried out for its landscape features with traditional Chinese characteristics and ecological wisdom. Regeneration is not only the protection of the traditional village landscape, but also adaption with micro-climate in the site including ecological wisdom [5].

2 Study Area and Data Collection

The case studies were collected from the traditional villages which are facing to the modernization and reconstructions in China and in Poland. A few of examples were selected from the design works by the modern Chinese Architects who were involved in the traditional village development during rural revitalization in recent years.

Most of the examples were collected and been analyzed by the design works from the students in Field of Architecture from Poznan University of Technology based on the Rural Architecture design projects. The traditional villages pilot areas were chosen according to the grant "Research on Ecological Protection and Rural Landscape in Ancient Villages in the Countries Along the Belt and Road Initiative—The selected Case Study and Comparison of Ancient Villages in China and Poland". Regarding to the Chinese traditional villages, the pilot area for research and design were focusing in the area around Beijing and Tianjin City as shown in Fig. 1. Related to the traditional Polish villages, the case studies were mainly selected in Greater Poland region as distributed in the Fig. 2.

The both sides of the case studies were tried to be applied into the project how revitalize the traditional rural areas where are facing the declining of population and economy because of big movement to the cities?

Although many polices and support put forward to the rural areas in recent years, but during the real rural development, more attention are still to paid on the vernacular architecture. In this paper, the author try to elaborate the modern rural housing design will be adaptive in the aspects as: using local materials, tradition, culture and surrounding environment with microclimate.

Fig. 1. The traditional Chinese village as the case study – Xijingyu Village location based on the distance Beijing and Tianjin City. Xijingyu village is shown in the Red area.

Fig. 2. The chosen case study for Polish traditional villages distribution in Greater Poland region as the small dots shown

Fig. 3. The stone is the dominated material for buildings in the traditional Chinese village-Xijingyu

Fig. 4. Wooden farming house with barns in Traditional Polish village-Babiak

3 Results

3.1 Using Local Materials

The local material can reflect the architectural regional characteristics by its unique color, quality, texture, and the construction way. The performance of local material's regional characteristics is realized by responding to environment, regional culture and technology of architect. The local architectures are living only if we on this basis. Aiming at the low-tech applications of local materials, sustainable development, and regional heritage, we actively explored the applicable application strategies of local materials with a view to providing references for the modern application of local materials, and to build a regional cultural heritage that is consistent rural folk architecture required by the different times. Regeneration of the traditional materials half-timbering provides visually understandable and esthetically accepted results on a façade. In Jixian County, Tianjin, there is a primitive village-Xijingyu Village, why it is named to be primitive, because the villagers there still maintain the original farming and lifestyle and the houses, walls, mills and many agriculture tools are made of stone. So it is famous by real "Stone Village". The stone houses in Xijingyu were mostly built in the late Qing Dynasty and their original appearances are still well preserved. The architecture of the stone houses is typical of the rural houses in Northern China. Due to the production of stone over the mountain around Xijingyu village, the local material is naturally become the prime materials for the construction as shown in Fig. 3, which showed the smart and adaptability very well in vernacular architecture.

Half-timber is proposed for the new settlement in Polish rural areas according to the research showed that most used materials in this traditional village Przygodziece and around this region were from wood in the past, which is very popular materials in Polish rural construction. Even nowadays, it is the easiest way to collect the wood for building in rural areas in Poland as we see in Fig. 4. Because of the local materials and rich wood resource in the past, it is the result that many rural house and barns were in log construction and covered by a high hipped roof widely as shown in modern design Fig. 5.

Fig. 5. Front Elevation of a horse Farmstead located in the traditional polish village Przygodzice designed by M. Wojtowska supervised by Mo Zhou based on the rural Architecture design projects

During the modernization process of the traditional villages, how the vernacular architecture adapt the modern design by using the local materials well? One side, the construction shouldn't be isolated from the materials like concert and steel etc. The other side, the tradition is kept by local inhabitants for over hundreds' of years, connecting the local tradition is very essential in this aspect as shown in Fig. 5. The author smartly used the half-timber for the modern rural buildings. The preservation of wooden architecture and maintaining its value can be achieved through conservation, adaptation, renovation and reconstruction.

3.2 Local Culture

A new branch of the Chinese bookstore chain, which opened in Xiadi village in Pingnan county, Fujian province In 2019, which is totally bringing the new concepts in terms of culture identity between the countryside and the big cities. The rural bookstore, surrounded by rice fields, was constructed in the shell of a traditional house. New houses are built on both sides of the road and are kept far from the old houses The bookstore was constructed in the shell of a traditional house with the surviving rammed-earth walls. Instead of abandon the remaining rural houses, the Architect Hua Li smartly designed the annex to solid the old building structure using the modern materials like concrete and steel as shown in Fig. 6. Moreover several rural projects over the past decade has been completed by her design already.

The bookstore branch was adapted from a renovated traditional dwelling belonging to the vernacular architecture in original. Nowadays, the society really appreciate that the eternal appearance of the modern structure can still keep in line with the vernacular architecture, which also help to maintain the traditional architectural styles of the ancient central China plains.

The identity of Chinese culture is deeply rooted in the countryside, and it is also the key factor to revitalize rural life through culture identity. Their main motivation is to return culture to the villagers, Meanwhile it can give rural children access to modern education, literature as well as obtaining knowledge.

Fig. 6. Xianfeng Bookstore built in Xiadi village in Pingnan county, Fujian province. The bookstore is designed by Architect li Hua and her team in 2019, Figure Source: https://m.thepaper.cn/newsDetail_forward_4728215

Fig. 7. The external view of the drama stage designed by Chinese Architect Yingbin Fu, located in Beihedong Village Shandong, China. 2018. The picture is provided by Yingbin Fu.

3.3 Tradition

Vernacular architecture is considered as a built environment based on local needs; defined by the availability of particular materials to its specific region; also reflects local traditions and cultural practices. Tradition is also passed by generation to generation.

Drama stages and the temples had kept the very important position in Chinese traditional villages for long time. A drama stage and the fork temple were usually the meeting point for the whole village and located often in the very center of a village in China.

It hold the role for rural constructions, celebrations, festivals and public meetings for the villages. In the modern rural design, the Chinese architect Yingbin Fu had gave this former traditional architectural element new life in new wave of rural reforms. In the new drama project as shown in Fig. 7, the old drama walls are discarded from the spatial formation, a huge floating skyhook ceiling is applied instead. Red is a favored color in Chinese traditional culture as well in the rural construction and decoration, which represents the good fortune. The drama stage is still adapting the red color as the dominated color in the basic structure, which is the best point to be accepted by the local inhabitants as well keeping the tradition in the modern design. Instead of the traditional beams in the stage, a big space for the drama performance opened in all four, the pavement beyond the stage extends to back of the square, there are designed the benches for villages having rest and meeting even there are no performance.

It provides more opportunities for various sport events, rural elections, festival performances and other public activities continue to extend the vitality of drama stages.

From the function and the appearance of the stage, the traditional culture life have been well inherited and adaptive in the rural modern architecture.

3.4 Surrounding Environment in Terms of Microclimate

Due to the specific location of the village - Chinese traditional village – Xijingyu is located over the mountain and the residential buildings along the contour lines over the slope, which is the consistent with ancient Chinese Feng Shui philosophy [5]. In the modern rural tourism development as shown in Fig. 8, there are new hotels for receiving the guest were also considering the specific location over mountain and more leaked to the valley. The modern design smartly avoid the strong wind flow from winter season as well providing the cooling wind surface to the in the summer time.

Fig. 8. It was drawn by M. Zembaty supervised by Mo Zhou in 2019 based on the Rural Architecture design projects in Poznan University of Technology.

4 Conclusion

As long as the vernacular architecture continues, it is essential to adapt the actual conditions to be modified in order to achieve the sustainable development together with the local inhabitants and its' own characteristics. The paper had elaborated the rural architecture is smartly adaptive into the modern design concerning the vernacular architecture with the aspects of using local materials, culture identity, tradition and microclimate. The rural contemporary architecture is completed by using the local materials in order to represent in the rural architectures with their high properties expressing the local complex of urban residents access to the ecological nature and environment surroundings. The cases studies in the paper have proved that modern rural design projects are quite often considering the tradition, folk culture, customs, villagers creation, aesthetic ideas and microclimate based on the local daily lives and production. Meanwhile vernacular architecture grows in the time context as long as gathering local peoples' experience, wisdom as well as their rich accumulation.

5 Discussion

In today's view, absorbing the local culture is was benefit the sustainability of the village in fact when considering the different climate and geographical environment [6]. There are many research related to the adaptation of vernacular architecture on contemporary architecture. It is still important to analysis and pay more attention from the aspects of sustainability development, keeping the tradition and adjust to the current modern rural life, using the local materials in rural regions and concerning the local microclimate to moderate the indoor environment more comfortable for the inhabitants during the modern rural design.

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Smart Mobility in Urban Development

Julius Golej(✉), Miroslav Panik, Daniela Spirkova, and Andrej Adamuscin

Slovak University of Technology in Bratislava, Bratislava, Slovakia
{julius.golej,miroslav_panik,daniela.spirkova,
andrej.adamuscin}@stuba.sk

Abstract. Bratislava as the capital city of the Slovak Republic is an attractive part of central European space and essential center of economics, services and education. Urban development, non-compact urban structure and gradual extension of the town by surrounding villages significantly influenced mobility within the Bratislava City. Despite that Bratislava belongs to European capital cities with one of the lower densities of population (1,146 inhabitants/km^2), non-compact residential form creates significant pressure on transport infrastructure. The submitted contribution focuses on the development of a new urban quarter in the center of Bratislava. The authors investigate the impact of particular developmental activities (building skyscraper quarter for two billion Euros) in the development area interconnected with the overall town mobility. The aim of the contribution is the evaluation of the suggested alternative solutions of the intelligent transport system in Bratislava, which are part of the development projects in the center of Bratislava.

Keywords: Smart mobility · Slovakia · Individual automotive transport · Infrastructure

1 Introduction

Currently, we are witnessing of the ever-increasing volumes of passenger transport based on the actual trend in the lives of city inhabitants and their background. The transport of persons by increasing using of individual transport is a source of environmental burden and a decrease in the life quality and therefore it is necessary to look for optimal solutions of sustainable transport in relation to the quality of service of the urbanized area. Transport of persons – "the mobility", is an essential condition for the efficient functioning of the country's economy. Mobility management (i.e. passenger transport) is a demand-oriented approach focused on influencing traffic habits and behavior of transport users.

Public transport (PT) in developed countries plays a primary role in promoting the development of society. Transport is not missing in any passenger-oriented document, which would not highlight the need and the necessity to direct the relocation of people from their resources to their objectives of activities other than by using public transport. Preference in congested areas, especially by individual automobile traffic (IAT) can be solved by the only right solution, which is intensive use of PT [1].

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The aim of this contribution is the evaluation of the suggested alternative solutions of the intelligent transport system in Bratislava, which are part of the development projects in the center of Bratislava.

2 Solved Area

The area of interest defined as a development area (namely - Nivy Zone) within the meaning of valid land-use planning documentation. The Nivy Zone without valid zoning planning documentation at the zone level is due to its location extremely attractive for its use as intensively as possible. This logically leads to the assumption of high volumes of newly generated traffic relations (roads) and thus raises the question of the functionality of its transport service by the various modes available. Of these modes, the greatest potential threat represented the individual car transport, which due to its high representation in the transport process has the highest infrastructure requirements. The second important mode in the area is public transport. An important fact is that within the documentation of the projects elaborated so far, have not been solved questions of the volume of PT roads generated by them and consequently the questions of the necessary capacities of PT offer and its remediation in the relevant subsystems (trams, trolleybuses, buses). Some elements of PT infrastructure, such as dedicated lanes for non-rail PT, stops, and access-walking routes, are design only partially.

In general, the cycling segment - only minimally represented in Bratislava (by 1.6%) and therefore it cannot influence the overall traffic situation even when it is possible increase.

The pedestrian segment in turn tied to its own infrastructure (footpaths, pedestrian crossings, pedestrian zones) and will respect in terms of capacity, in cases of its accumulation with the segment of the most problematic road transport. For these reasons, the focus will be on the automobile transport and PT segments.

In view of the facts stated in the introduction, it is clear that, in order to achieve a sustainable transport situation, it is necessary to adopt measures of a more fundamental nature, both in the area of mobility and in the area of road infrastructure, to develop the Nivy Zone especially in sectors not yet addressed.

The basic quality parameter of the assessment of the transport process in terms of passenger transport (Mobility) is the division of transport work [2].

A household traffic survey [2], divide this characteristic of the traffic behavior of the citizens of Bratislava into individual modes of transport:

- Individual automobile transport (IAT),
- Public transport (PT),
- Cycling transport,
- Pedestrian transport.

Figure 1 shows the percentage distribution of transport work.

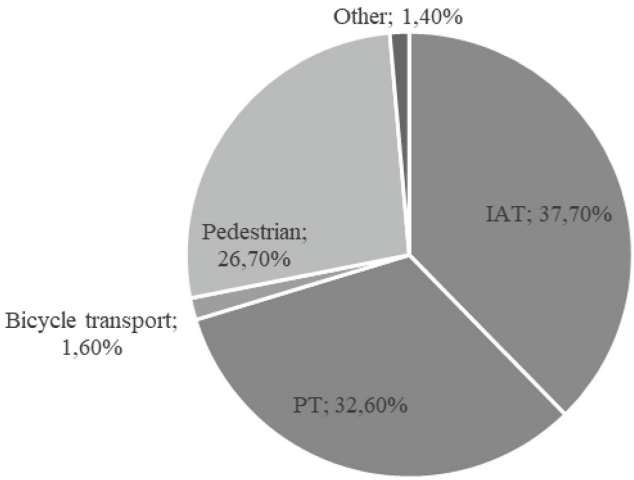

Fig. 1. Division of transport work in the city of Bratislava. Source: [2]

2.1 Investment Activities in the Area of Interest - Nivy Zone

Position of the Mlynske Nivy Bus Station is in the new city center of Bratislava. The large construction of new investment activities (actually Nivy Zone is the largest construction site in Central Europe), which will form the modern part of the city's face, is now preparing and realizing near the new Bus Station. Figure 2 shows a schematic representation of individual investments.

Fig. 2. Investment activities in Nivy Zone. Source: [3]

Due to the ongoing activities in the area under consideration, many of which are still in preparation, it is not possible to determine the exact number of jobs and the number of new inhabitants. This number can estimate based on data on the number of planned parking spaces, the total number of which are more than 22,000. Based on this data, the number of jobs and the number of new residents can estimate at a minimum of 22,000. In any case, these figures represent very high figures for the number of new vehicles in that territory.

3 Data and Methodology

The evaluation of the proposed alternative solutions of the intelligent transport system in Bratislava, which are part of the development projects in the center of Bratislava, realized on four scenarios (solutions). Each of these scenarios represents an unrealized solution to the traffic situation in the area of interest, resulting in a % expression of the relief of the area from the problematic IAT.

In calculating the level of congestion in the NIVY site, we used data maps (see Fig. 3) of the individual automobile traffic load provided by the Territorial General Plan of Transport [2], which by means of statistical surveys provides information on IAT passengers' behavior on a so-called record date. On that day, residents who made at least one car journey made 14.5 km per person, which is 290 km per person in twenty working days per month. Automobiles are occupied on average of 1.5 persons.

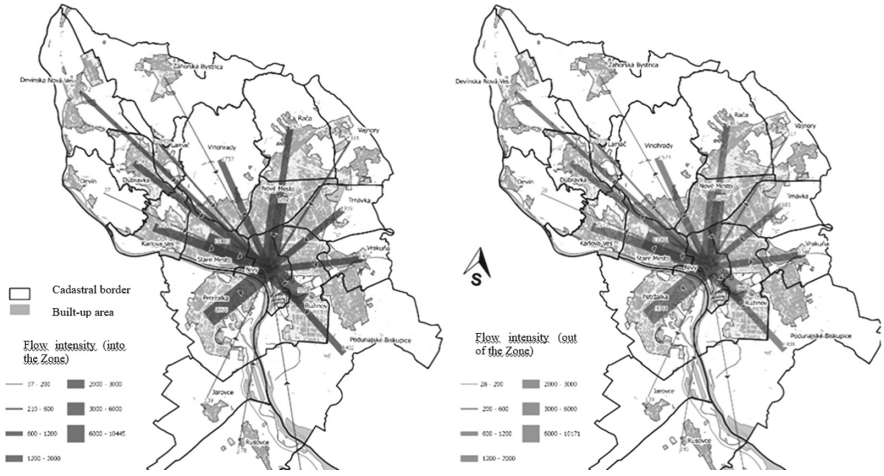

Fig. 3. Traffic load of the Nivy Zone - total traffic flow intesity from different directions. Source: [2]

3.1 Scenario: Cable Car from Petrzalka District to Nivy Zone

The project developer of Nivy Zone wants to address the improvement of the traffic situation in the developing area by building a smart cable car across the river Danube. An innovative overhead electric track for 50 million Euros is to lead from the newly built Bus Station to the University on the other side of the river – in city district of Petrzalka. At the beginning, it should have four stops and it should transport from three to four thousand people in an hour, which would total two million people a year. On the Petrzalska side, the developer plans to build a large-capacity garage house for 30 mil. €.

In the modeled area of Nivy Zone, the total load of the area is defined by the amount of all journeys made on the measuring day, going to the site, but also from the Nivy Zone back to different directions of the city. The total load is 97,663 journeys. In this scenario, we examine the possibility of reducing the traffic load in the event of realization an overhead cable car from Petrzalka to Nivy Zone. Table 1 shows the total loads from these areas. The number of journeys from the Petrzalka area is 18,020. We assume that 35% of passengers will replace the IAT with a new cable car transport possibility. Then the total number of journeys made from which the traffic in the Nivy Zone will be relieved from the direction of Petrzalka district is 6,307, which is 6.5% in relation to the total load of 97,663 journeys.

Table 1. Total load of Nivy Zone and number of journeys

Indicator	Quantity
Number of registered vehicles in Bratislava	391,975
Number of journeys in Bratislava on the measuring day	190,400
Number of journeys to Nivy Zone (from all directions of the city)	48,986
Number of journeys from Nivy Zone (to all directions of the city)	48,677
Number of journeys to Nivy Zone from Petrzalka	8,976
Number of journeys from Nivy Zone to Petrzalka	9,044
Number of journeys from Nivy Zone to Ruzinov district and back	18,766
Number of journeys from Nivy Zone to Vrakuna district and back	2,752
Number of journeys from Nivy Zone to Biskupice distr. and back	2,810
Average number of people per automobile	1.5

Source: [2]

3.2 Scenario: Construction of a New Tramway Radial

Tram transport in Bratislava is provided on a rail network of 1000 mm track gauge. The tram network currently consists of three eastern radials, one west and a track to the main station. In the modeled area of Nivy Zone, the total load of the area is defined by the amount of all journeys made on the measuring day, going to the Zone, but also from the Nivy Zone back to different directions of the city. The total load is 97,663 roads. We are investigating the possibility of implementing the new tramlines and subsequent reduction of the traffic load in this city part.

The total load from these areas shows Table 1 above. The total number of journeys from these areas is 42,348. We assume that 35% of the passengers will replace the IAT for transport by tram. Then the total number of journeys from which the traffic was relieved in the Nivy locality, from the direction of other city districts (Ruzinov, Vrakuna, Podunajske Biskupice and Petrzalka) is 14,822, which represents a 15.2% reduction in relation to the total transport load of 97,663. The use of tram transport has many economic, social and urban benefits. Other benefits are also low environmental pollution, more energy efficient transport, accessibility for all people and less space needs to transport the same number of people.

3.3 Scenario: Park&Ride System

The third scenario describes the possibility of relieving traffic if we implement the P&R system. P&R system would include a Smart Parking System that monitors vacancies using wireless sensors and provides information on the one hand to drivers and on the other hand to cities about occupancy of the parking lots.

According to the analysis (Table 1) [2], 18,020 journeys are realized from the Nivy Zone to the Petrzalka district and back. The capacity of the car park will be 1,150 of parking places [4]. Cars that make the trip two times will relieve the Nivy Zone by 2,300 journeys. At full utilization of P&R system, the total transportation load of this territory is lower by 12.8%.

3.4 Scenario: Car-Sharing

Complementary services of alternative types of transport, which are being prepared within the city of Bratislava, are very important. These are both bike sharing and car sharing services. There is a high expectation that, as well as the premises; these services will be available, which would otherwise complement public transport services very well [1]. We consider the car-sharing alternative to be very underdeveloped in Bratislava and throughout Slovakia. The city of Bratislava is considering four sites to build its standpoints for car sharing, with 10 cars each [2]. Car sharing should be cheaper than a taxi service and more expensive than a public transport ticket. In the context of a parking policy, the price should also be lower than the price for residential parking.

The most developed is the car-sharing system in Germany, where 78% of the population live without their own car. Private car ownership has fallen by one fifth, and it is estimated that each shared car can replace 5–10 private cars [5]. In the case of Bratislava, where 391,975 cars were registered in 2018, the introduction of a large-scale urban car sharing system could ensure a total reduction of 78,395 cars, which is 20% of the total amount.

4 Conclusion and Recommendations

The development in this area is so extensive that currently realized investments and measures in the transport infrastructure would not be sufficient for sufficient servicing of this area. So far, demonstrated cumulative increase in traffic relations is on average

to load of the communication network already reached (sometimes even exceeded) the upper permeability limit of selected elements of the most affected communication network [6]. The situation is caused not only by the high intensity of land use, but also by the proportion of individual automobile transport in the division of transport work, which corresponds to the city-wide average, but seems too high for the area in contact with the Central City Area with such high intensity.

In order to achieve a sustainable transport situation in Nivy Zone, it is necessary to adopt measures of a more fundamental nature, both in the field of mobility and road infrastructure. Specifically, prefer servicing the territory by rail transport, which would comprehensively address the system integration of the public transport. Building a complex P&R system that would increase the intensity of PT use. By the word complex, we mean minimal distances on PT, minimal time intervals of individual connections and PT preference in the traffic solution of the city territory at the expense of the collapse of car traffic.

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Proposal for a Green Area Master Plan. Case of Study: Nueva Aurora Cooperative, Daule, Ecuador

Cyntia Alava Portugal(✉) and Jesús Rafael Hechavarría Hernández

Faculty of Architecture and Urbanism, University of Guayaquil, Cdla. Salvador Allende, Av. Delta y Av. Kennedy, Guayaquil, Ecuador
{cyntia.alavapo, jesus.hechavarriah}@ug.edu.ec

Abstract. In the last 10 years, there has been a significant increase in population in the Aurora parish, because of the migration due to the lack of expansion in Guayaquil City, devastating agricultural land and converting them into serial private developments on the one hand, as well as in disorderly human settlements in the cooperative of the same name, the latter being an unplanned development, which ended in almost no vegetation spaces, generating greater environmental pollution, temperature rise and lack of CO_2 uptake, translating it to health problems in the population The present work proposes the creation of a master plan of green areas in the cooperative "Nueva Aurora" for the improvement of the urban landscape and enjoy socio-environmental benefits that can be obtained from good planning, This work shows the importance of the relationship between territorial planning and green areas, since its inclusion in the human environment helps to improve his quality of life.

Keywords: Urban landscape · Green areas · Territorial planning · Quality of life

1 Introduction

Accelerated urban growth in the Aurora sector, at the same time as urban mobility [1], make it difficult to carry out proper planning of the territory, which is used to the maximum for construction, forgetting the green areas that are necessary for well-being of the population [2], as well as to increase diversity, and the lack of them generates higher temperatures [3], adding to this the pollution caused by vehicular traffic [4].

The Territorial Planning and Environmental Management of the urban parish La Aurora, has been marked by agricultural land and its remarkable rice production [5], as well as, an important inter-regional connection especially of primary products, the same as currently It is affected because it is not possible to cover production costs, so there are several factors that imply leaving agricultural activities to seek improvements in the economy [6], and after that turning this land into urban, which although it originates Remarkable economic growth is also closely linked to environmental pollution [7], since it is proven that construction is one of the most harmful industries for the environment [8].

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It is because of the deficiency and lack of planning of these green areas and urban landscape, indispensable for man [9], that a plan for the creation and conservation of green infrastructure [10], identifying urbanizable areas, must be promoted to create a design of green areas with the acceptance of the inhabitants of the sector [11]; and since man is linked to the environment, it is necessary to include a master plan of green areas for the Aurora cooperative within the territorial planning plan of the canton Daule [12], which contributes to sustainable development, integrating these spaces with the urbanized territory [12].

2 Methodology

The methodological design to be performed is descriptive. For the Identification of the zones, the Google Maps tool will be used to identify the green areas and developable area through maps with their respective land extensions. Then a visit to the site will be made to observe what the vegetation is made of and what characteristics the place has.

The representatives of the sector will be contacted to facilitate the collection of data through a structured survey with the objective of obtaining information on the nature or landscape in the study area, based on which participatory workshops can be held in which the design of parks and green areas will be developed.

The aim is to prepare a Green Areas Master Plan for the Nueva Aurora Cooperative, and to find out if the population of the sector considers it necessary, a sampling was carried out, for which inclusion and exclusion criteria are established. The following were considered in the study:

- Sex: male and female.
- Ages between 18 and 60 years old.

According to the cadastre of the year 2001, the Nueva Aurora Cooperative has 711 pre-god, distributed in 449 for Nueva Aurora and 262 for La Gloria, currently considering an average of 5 people per property, data obtained by the municipality of Daule to estimate the value of the total population, which amounts to approximately 3,555 people.

Of this total, 40% are minors and 10% are over 60 years old, which indicates that 50%, that is 1,778 people, are part of the population valid for the research sample.

The type of sampling used for the structured questionnaire is of the stratified probabilistic quantitative type based on the information of local actors linked to the planning of the sector studied.

Analysis Unit: People who live in the Nueva Aurora Cooperative and whose ages fluctuate between 18 and 60 years of age.

Population: People who live in the Nueva Aurora Cooperative and whose ages fluctuate between 18 and 60 years of age.

$$n = \frac{Z_{\alpha}^2 Npq}{e^2(N-1) + Z_{\alpha}^2 pq}$$

Sample: The sample size was determined using the following formula:

With a 95% confidence level (1.96) and a sample error of 5%, replacing:

$$n = (3,84 * 1.778 * 0,5 * 0,5)/(0,0025 * (1.778 - 1) + 3,84 * 0,5 * 0,5)$$

$$n = 315,94$$

The sample to carry out the structured questionnaire is 316 people. 344 respondents were obtained, increasing the safety margin by 9%, in order to assess the community's perception of the incidence of green areas in their environment, generating information that can be considered in decision making and local planning.

2.1 Results

The results of the surveys show cross tables and bar graphs that show that 301 respondents (most) agree that the ambient temperature is high and need the inclusion of green areas in the study site, while 29 consider it bearable and only 12 pleasant Fig. 1.

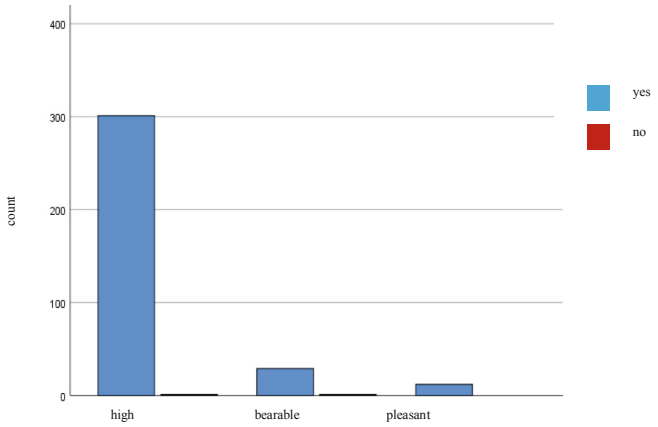

Fig. 1. Consideration of the ambient temperature according to the respondents

In the same way, respondents who consider the high ambient temperature are those who agree to have parks with many trees as a priority, and areas for walking or cycling in second place Fig. 2.

We also observe that 66.6% of the inhabitants consider that the traffic is high (Table 1), which is related to 94.5% who think that this affects their health (Table 2) and with 98.8% who believe that health would improve if they include green areas in the sector (Table 3).

After analyzing the results, a design scheme of green areas for the New Aurora Cooperative was carried out, in which the studied area is practically enclosed and in the middle it is divided both horizontally and vertically to try to improve the quality of the environment and landscape Fig. 3.

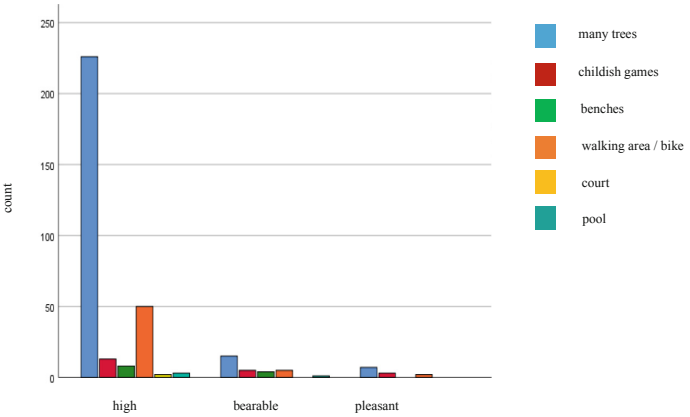

Fig. 2. Those who consider the temperature high want many trees in parks

Table 1. Percentage of how vehicular traffic is considered on the main avenue of the Aurora

Traffic	Frequency	Percentage	Valid percentage	Accumulated percentage
Low	40	11,6	11,6	11,6
Medium	75	21,8	21,8	21,8
High	229	66,6	66,6	66,6
Total	344	100,00	100,00	100,00

Table 2. Percentage of people who think if traffic affects the health of the inhabitants

Answer	Frequency	Percentage	Valid percentage	Accumulated percentage
Yes	325	94,5	94,5	94,5
No	19	5,5	5,5	5,5
Total	344	100,00	100,00	100,00

Table 3. Percentage of people who consider that the health of the inhabitants would improve by creating parks and green areas for the sector

Answer	Frequency	Percentage	Valid percentage	Accumulated percentage
Yes	340	98,8	98,8	98,8
No	4	1,2	1,2	1,2
Total	344	100,00	100,00	100,00

Fig. 3. Green areas design scheme

3 Conclusions

The results of this research show that in the Nueva Aurora Cooperative according to the maps used there are no longer arable areas, and that most of them are urbanized. The inhabitants of the sector agree that an increase in green areas is needed since man has a strict link with nature, in order to mitigate the effects of high ambient temperatures and vehicular traffic; It would also help to recover biodiversity and the ecosystem issues that have been lost due to the lack of planning of green spaces at the time of urbanization. For this, a design of green areas as connected spaces was made that apart from being distributed for the entire population is subject to environmental sustainability and urban landscape, from which the Green Areas Master Plan is obtained whose purpose is to include it in the Territorial Planning Plan of the Daule canton.

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Comparison of Regeneration Mechanism on Public and Private Subject of Small-Scale Historical Blocks in Chinese City

Shun Yin[1(✉)] and Weiwei Yao[2]

[1] School of Art Design and Media, East China University of Science and Technology, No. 130 Meilong Road, Shanghai, China
63329343@qq.com
[2] College of Architecture and Urban Planning, Tongji University, No. 1230 Siping Road, Shanghai, China
Shyww07@Gmail.com

Abstract. Based on the surveys of renewal subjects and the operation mechanisms of two similar cases in historical urban district of Qingdao City. this research proves that the private subject has adaptivity in the small-scale renewal: while the public subject has been faced with a large amount of supervision, examination and approval costs, and the investment of a large number of policy-oriented fund, to some extent, impedes the intervention of social capital through market mechanism. Public subject in this kind of renewal project is not adaptive, its role should embody in establishing flexible regulation mechanism, setting up the approaches to privatization. In this paper, by deep study of the specific case, formed to explain the cognitive model, for the large number of domestic historical living street blocks to achieve public-private partnerships and multiple participation providing the possible strategies.

Keywords: Liyuan · Tapautau · Historical district · Renewal mechanism

1 The Research Background and Purpose

The research object of this paper is the historical block whose original main function is living. As the most common type of present domestic historical block, due to its properties of old urban residential area, its space and property right are various and complex, therefore it has a larger difficulty to renewal; compared with the large-scale holistic development under a single development subject, the renewal method with small scale, gradual model and participation of multi-subjects is gradually accepted by academic circles recently, and it is considered that this method may avoid grand narrative of programme and is more conducive to ensure the diversity of the city. In this stage, the government construction management department is also aware of the complexity of the large-scale unified transformation, more actively involved in small renewals to the historic district renewal.

In this paper, by comparing the two small renewals cases of the operation of the public or private subject respectively trying to give suggestions for how to construct an adaptive renewal mechanism. Through the investigation on organizational structure of

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operation subject and detailed process of project operation, conduct contrastive research from organization subject and operation model these two levels, analyze different difficulties faced by public and private subjects, adopt different operation model to obtain differences of results, then systematically expound the advantages and difficulties of the operation mechanism respectively adaptable for public subject and private subject and the correlation between subject and operation method as well as renewal result, so as to describe that how renewal mechanism plays its role, thus provide possible paths for large number of historical living blocks in China to realize public-private cooperation and multiple participation.

2 Investigation

Research case of this paper is located in the core block of historical urban area of Qingdao City. It preserves the historical building material heritage since 1898, the starting time of the city's development (Fig. 2). With evident cultural and regional resource advantages, it is the most important urban area of Qingdao. As early as 1999, Qingdao Municipal Government has started to plan the overall transformation of old urban blocks. However, the large-scale integrated development is lack of adaptability in the renewal of successive patches of living historical urban blocks. It gradually transfers the focus to small-scale renewal pilots, and try to start the renewal work by means of

Fig. 1. The map of Qingdao City in 1990, and the outline of two cases in this paper can be seen.

Fig. 2. Right picture, the overall renewal planning scope of the old urban district in 2015 and two small-scale renewal cases.

taking one unit to guide the whole area (Fig. 2). Private and state-owned assets subject to operating respectively. During the period from August 2015 to April 2016, relevant data and materials were obtained by taking part in the actual operation of WX-19 building modification scheme design, combining with several rounds of discussion meetings and interviewing relevant principals; through several times interview of investors of BD - 10, have got relevant data and information. Investigation is carried out in aspects of project planning, expropriation, property right arrangement, organizational structure of operation subject, restricting factors of renewal target and so on (Fig. 1).

3 Analysis and Results

(See Table 1 and Fig. 3)

Table 1. Similarities and differences of the case

Similarity	Properties	WX-19	BD-10
	Architectural value	Historical buildings	Historical buildings
	Building years	1914-1936	1903s
	Building stories	2-5 floors	2-3 floors
	Plot ratio	1.8	1.4
	Floor area ratio	72%	68%
	Construction area	8670m^2	2100m^2
	Function before update	Courtyard house + commerce at the bottom	Courtyard house + commerce at the bottom
	Project starting time	2012	May, 2014
	Renewal mode	Renovate	Renovate
	Commercial activities after	Hotel + retail + Restaurant	Hotel + Supporting business
Difference	Operator	The Municipal State-owned Enterprises	Private Investors
	Source of fund	CDB low-interest	Self-financing
	Present management	Not operation yet	Good

Fig. 3. Relative position of BD–10 and WX-19

3.1 Basic Condition and Renewal Effect

BD-10 was built during the period when Germany leased this land in 1903. It is consisted of two buildings with courtyard pattern and masonry structure. Its original function is German barracks, in which the downstairs area is used for horse keeping and upstairs is used for living; during 1930s shops along one side of the main street were banks, and their inner courts were congregate residences; in 1950s after the public-private joint management, this area was transfered to the First Western-style Clothes Plant, and the pattern of first floor was "front store and back plant", and the second and third floor were dormitories for the plant staff. BD-10 is renewal by social forces and market behavior. W, a local investor of Qingdao City, invested more than 5 million yuan of initial capital in March 2014. From the commencement in May 2014 to operation in November 2014, with 8 months BD-10 has been transformed into a small hotel with 48 rooms. Taking advantages of the tourism resources of old urban area and historical and cultural characteristics of interior yards, the operation condition of BD-10 is very good, and its turnover in 2015 is nearly 3 million Yuan (Fig. 6, 7, 8) (Fig. 4).

Fig. 4. WX-19 Street in 1901

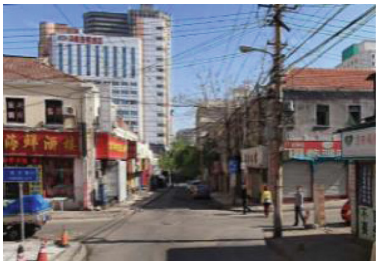

Fig. 5. WX-19 Street in 2015

WX-19 (Fig. 5, 6 and 7) is the typical liyuan buildings which consist of four nested courtyards. Most of the existing historical buildings were built from the period leased by

Germany in 1901 to the period of former Kuomintang government in 1936. The buildings are the warehouse and dormitory of Sanxing Company, new type liyuan buildings which were rebuilt in 1933–1936 and a public bathroom respectively, Tiande Hall, which was built in 1936 by Jin Shengqing, a Zhejiang businessmen, and was the largest one in the same year, and they were still the public buildings generally used by the citizens in the old city until the 1990s. With the continuous erosion of the old city, the government decided to take No. WX-19 as the reconstruction start-up project to improve people's livelihood and revive culture, and 2 million funds was invested to start acquisition in 2012, while there are tens of households that are still not collected yet by now. Architectural design and post-stage operation have made initial progress after multiple arguments, but the progress of the project is quite slow limiting by the collection (Fig. 9).

Fig. 6. WX-19 state before renewal

Fig. 7. BD-10 before renewal

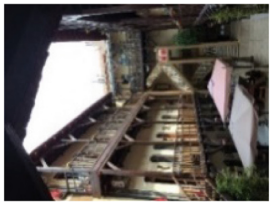

Fig. 8. BD-10 after renewal

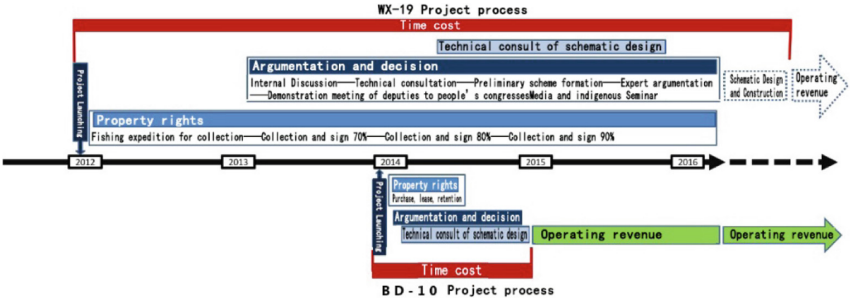

Fig. 9. Comparison of project process and time cost between BD - 10 and WX – 19

Two cases were renewald by public and private entities respectively, the results have a greater difference. There is contingency of the case, but also has the inevitable result of the subject's own property. The comparison between project progress and renewal mode is made in the following passage, which also further discusses the laws behind phenomena from both project property and subject attribute.

3.2 Project Process and the Property Right Arrangement

According to project procedures (Fig. 10), both cases will experience four similar stages: I. the stage of property right arrangement: meeting the requirements to carry out land first-class development and arrangement through integration of complicated and nuanced property right to obtain approval for the project; II. Demonstration and decision-making stage; III. Project design and construction stage; IV. The operation stage. After the completion of the first three stages, the project can enter into the operational phase of the yield, time cost of the project has a significant impact on the economic benefits. From two cases of time schedule comparison shows that the property rights of the stage have a greater impact on time cost (Fig. 11).

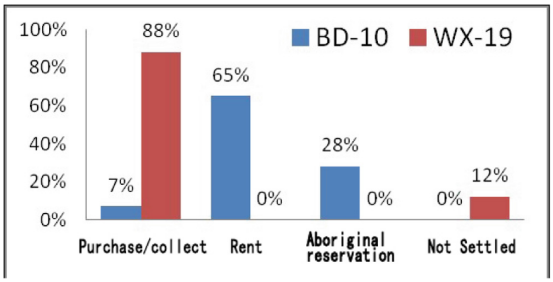

Fig. 10. Comparison of property right arrangement

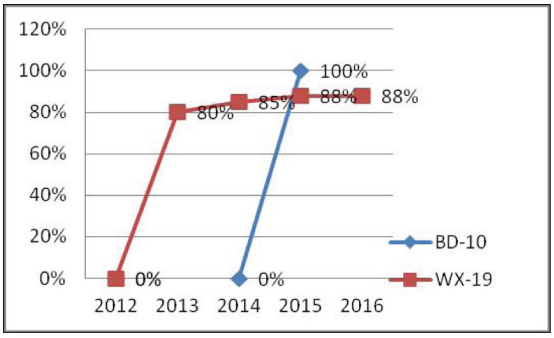

Fig. 11. Comparison of the process of property right arrangement

The detailed working methods carried out by private objects can deal with renewed operations and contradictions left over by aborigines, which has exerted important enlightenment on solving real difficulties: on one hand, the success of this case proves that the existence of aborigines is not an absolute barrier for business operation, both exploitation benefit and balancing aborigines reservation can be achieved by detailed design techniques and mastering the demands of the aborigines, in other words,

"the update work can't be carried out before transfer of property right" is a kind of fixed ideas dependent on rigid administrative progress; on the other hand, what the public objects execute is local expropriation policy, which stresses rules of fairness according to regulations, while the private object can reach more flexible cooperative contract through negotiation with aborigines. Of course, the success of case BD-10 also explains the geographic advantages of local investors, i.e. private objects posses the ability of space dominance of localization and can timely choose projects with maximum "rent gap" through folk information network. The public objects also attribute failure of property right arrangement to the rigidity of land policy, while the private object can break the deadlock of the policy. The reason behind it is the difference of the unity degree of the responsibility right.

3.3 Responsibility and Right

Investor of BD-10 fully participates in aboriginal communication, design discussion, supervision of construction and operation management, And ensures the implementation of the target to the execution. This way about "small scale" full control saves the cost of cooperation and communication. WX-19 is developed by municipally-owned enterprises through special purpose loan, but the executives of collection are collection office of the district government. Aiming at coordination, the Qingdao Municipal Government established two "headquarters" in 2012 and 2014 to make overall plans and coordinations. But, the temporary commanding agency has no administrative power to remove the district-level collection office, and benefits after development belong to the municipal enterprises, while the hard collection work is the responsibility of the district-level units (Fig. 12). Management mode of disunity of the responsibility and right is the crux of the slow progress.

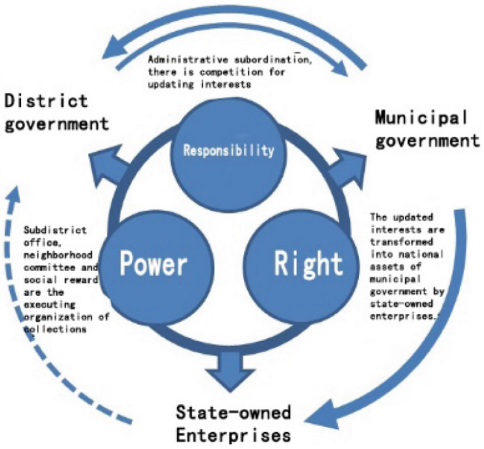

Fig. 12. Distribution of the responsibility and right in WX-19

3.4 Approval Process and Supervision Process

The WX-19 project nature is attributed to the redevelopment after land consolidation, the operation of land use variation and adjustment of plot ratio can be conducted through project approval process, which is as per the existing land consolidation policy, and can enter the rearrangement process of land after completely recover the individual property rights, further carry out the project approval work. BD-10 doesn't need land consolidation and project approval, as the land usage hasn't been transformed, and the repairing process is only removing illegal building without change of height and plot ratio, which equals to the "decoration" of folk houses. Investors of BD - 10 control the project properties to avoid the complex approval process.

The operating agency of WX-19 is a state-owned property company directly under the municipal construction department, the fund use is under the supervision of auditing system, a large amount of expense must conduct purchase service according to the flow of government purchase center. The strict supervision on purchase and currently plenty of social enterprises haven't been incorporated into the purchase system of government, directly leading to the administrative cost when WX-19 executes plan and the cooperation cost with the downstream service company. Visible, the difference between the approval and regulatory processes is mainly determined by the two factors of the project and the operation.

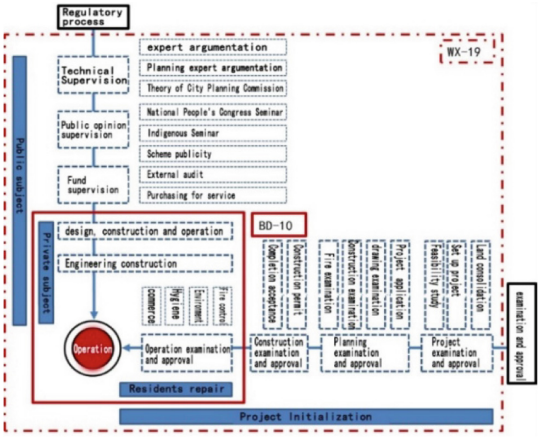

Fig. 13. Horizontal direction on behalf of the approval process, vertical direction on behalf of the regulatory process.

It can be seen from Fig. 13, because of the difference between the main attribute and the attribute of the project, it brings the difference of "operating cost". The public subject "formal" process links are too much, lack of flexible mechanism setting up to improve the efficiency. And the "informal" operation of the private subject is very simple but lack of supervision. Under the renewal driven by economic benefit, whether it can consider both the architectural conservation and aborigines completely depends on the intention of investors, the renewal of private subjects without supervision has high risks for cities.

4 Conclusions

4.1 The Private Subject Is More Suitable for Residential Small-Scale Renewal

The special environment that renewal work of residential historical block confronts is property right consolidation, private subjects have self-adaptability: the high uniformity of responsibility, right and benefit can guarantee the executive force when facing complicated work, which is shown in the control of time cost and high efficiency. In addition, from the angle of operating cost, private subjects have more advantages, while the public subjects make the operating projects be confronted with review and supervision, when operating small-scale renewal projects, it is confronted with the problem of high operating cost and low output benefit, which also can explain why the public subjects tend to the large-scale uniform planning.

4.2 The Private Subjects Is More Conducive to Economic Benefits

Local operators can utilize the folk informal organization to seek the idle resources in old city and seek value depressions, making the architectural cultural heritage of the old city quickly produce economic benefit through market operation. Most of the economic benefits were obtained by the merchants, and the other part was obtained by the original owner of property rights, the government can also obtain the public interest in tax and livelihood improvement. Although public subjects can utilize financial resources, with the restriction of low timeliness, large loans produce the consumption of economic benefit, when the time cost in early period is transferred to the operating cost in later period, it equals to indirectly consuming the value produced by the old city.

4.3 The Public Subject Should Construct Intervention Cooperation Paths of Social Capital, and Flexible Regulatory Mechanism

The Policy of China always has a strong intervention effect on urban renewal, so private subject is often in a passive position. When having an interview with BD-10 investor, deeply feel that he has a strong desire for continuing to improve similar cases, the large-scale collection policy will make the compensation fund earnings exceed the earnings from property right selling towards private subjects, causing the aborigines to be reluctant to cooperate and expect the implementation of collection. But the public subjects can control the resources through policy with the help of the direction relation with government, and establish public-private partnership path, and maximize the value of the old city with the help of executive force of private capital. Meanwhile, form an elastic supervision mechanism for private subjects, through the long-term experience of similar projects, lower the operating cost and lower the risk formed against historical and cultural heritage due to the rapid promotion of private capital.

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Application of BIM Simulation and Visualization in Landscape Architecture Design

Xia Wei(✉), Wojciech Bonenberg, Mo Zhou, and Jinzhong Wang

Faculty of Architecture, Poznan University of Technology, Poznań, Poland
wei.x.1028@gmail.com, jinzhong.wang619@gmail.com,
{wojciech.bonenberg,mo.zhou}@put.poznan.pl

Abstract. Through theoretical analysis and case study, this paper discusses that BIM technology can optimize the design of landscape architectural projects and make the landscape architectural design more reasonable. BIM's landscape architecture also demonstrates how BIM can enhance collaboration with other professional designers and customers, streamline information processes, and improve decision making. BIM delivers well-designed landscape projects on time, schedule, and budget. This article focuses on exploring and studying the organizational, technical, and professional practices of BIM adoption. And it discusses in detail the standards, structures, and information flow that form the BIM-compliant workflow, highlighting the new working methods that landscape design professionals need in BIM. It also delved into the digital tools used in BIM projects, emphasizing the "information" in building information models. And the possibilities offered by landscape-rich models in landscape design, maintenance, and management.

Keywords: BIM · Landscape architecture · Simulation and visualization

1 Introduction

In all construction projects, the first step is always to do site analysis and have a draft to design. Only when there are scientific data and intelligent information systems in the design stage, it really can be truly sustainable in subsequent projects? The mastery of BIM applications in the construction industry is very mature, and the entire life cycle of buildings can be applied in the context of BIM digital information models. Nowadays, the landscape architecture has also tried to explore the application of BIM technology and applications during the process of design, such as geographic information based GIS and LIM landscape information models. Applying BIM technology to landscape architecture projects, it is necessary to integrate information about the growth of different species of vegetation. Such as the required changes in soil conditions, moisture content, and sunlight exposure, considering them into the BIM information model to establish A dynamic data model that changes as plants grow. Only in this way BIM technology can be genuinely applied to landscape construction projects [1].

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In landscape architecture design projects, it is very often to use BIM technology, designers, investors, constructors, and users to share a centralized database, including many components, such as windows, brick walls, fountains, trees, etc., which is accompanied by a large amount of information. For instance any data related to a given component, such as weight, size, material, or manufacturer's website [2].

Landscape architecture will grow like things in nature as long as its growing conditions and the ambient environment. If BIM technology is applied, landscape architecture can be intelligent related to its growth, composition, and changes can be concentrated in digital models. For designers, BIM simulation and visualization are particularly crucial in the early stages of project design. Each project starts with the design. In the past, designers needed to make multiple changes to the design plan. In the infinite loop of reporting and modification for a long time, precious time and energy were wasted. After using BIM technology in the initial design stage, the situation has dramatically improved, and designers and investors have the right way of communication. Besides, the information model of BIM technology is easy to modify. In the later stage of drawing, you only need to update any part of the model. All other graphics, including the effect diagram, can be modified at once. Sustainable design is an inevitable trend in the development of landscape architecture design.

2 Research Problem

2.1 The Status of BIM in Landscape Architecture

Using advanced technologies in the context of maximum collaboration between operators and the BIM technology process has generated a new data perspective. It is beneficial for intelligent and sensitive space planning related to environmental conditions. BIM technology is committed to providing a more efficient and rapid design timetable. What is more, applying BIM technology can optimize the layout and coordinate to achieve higher energy efficiency even in a limited space.

With the rapid development of BIM technology in the construction industry, the landscape architecture industry is also exploring the application of BIM technology. However, compared to other industries, the development of BIM technology in the landscape architecture industry design is relatively slow [3]. The reasons are quite complex e.g. the lack of market demand from investors and constructors, the lack of a professional landscape architecture design analysis and evaluation system in design projects, the limited scale of the industry, and the technical difficulties. However, the spatial planning and construction drawings of landscape architecture design projects are facing urgently to require the support of BIM technology. In the landscape architecture industry, many people are looking forward to the development of BIM application technology.We do hope that BIM technology can also enter the landscape architecture design market soon. But in fact, the application of BIM technology in landscape architecture design is still very few. We know no landscape projects with a complete set of systems have applied BIM technology in recent years.

With the improvement of people's living standards and rapid economic development, to create a better living environment and supporting comfortable and livable

architectural landscapes, the level of architectural landscape design must be improved in the early stages. Applying BIM technology to landscape architecture design, you can use the information model of BIM to do various simulation analysis in the early stage of design to ensure the scientific and economical of landscape architecture design. At present, traditional landscape architecture design mostly stays at the initial stage of hand-drawing. Due to the different levels of designer hand-drawing, usually it is hard to express the designer's intentions to investors to imagine what the final effect of the design is. Visualization is also a big problem. If the design does not convey the complete design intent, there will be a lot of inconsistencies in the later stages of the project. In landscape design, the designer needs to know many professional disciplines such as aesthetics, psychology, architecture, and planning. Therefore. the visualization technology in BIM can make the expression methods more direct, such as VR, people walking simulation and the animation of landscape architecture design can also further express the designer's intention, which makes the public more acceptable. If BIM technology can be used in landscape architecture design, all plant characteristics, features, growth characteristics and contributions to the landscape can be shown at once. Using data to explain everything is more clear comparing to traditional landscape design. Developing landscape architecture in a sustainable way and using of BIM technology in landscape architecture design are essential.

2.2 The Problems of BIM Application in Landscape Architecture

Building Information Modeling has become the default digital format for designing buildings, bridges, and other infrastructure worldwide. In theory, it should be equally applicable to landscape design. Many landscape designers are eager to use BIM for landscape design instead of not understanding the information-rich methods of BIM technology. However, if the BIM application technology of landscape architecture design is compared with the BIM technology of construction engineering, it is still relatively backward [4]. The following are the problems of landscape design in the use of BIM:

- **Software:** For landscape architects, the shift to BIM can be a little disturbing. However, while it is relatively easy for architects and construction engineers to transition from CAD to BIM, there are still software gaps once in the landscape.
- **Professional design and technical personnel:** Landscape architects are relatively a small group of professionals. The results of any professional technology are not achieved overnight. It takes a long time to continuously update the technology and to develop BIM to Landscape industry comparing to current architecture industry.
- **The application technology has limitations:** The 3D model of BIM needs to be very fine, and it takes a lot of time to make a BIM model. BIM's design center is data and information, but no one has ever bothered to collect data. For landscape architects, in the field of landscape design, BIM is a cumbersome, architecturally-centric, and a complicated tool.
- **Poor application environment:** Unlike the BIM application in the construction industry, which is being promoted by the government, few investors or builders in

the landscape design require the application of BIM technology to improve efficiency and quality so far.

3 Research Methodology

3.1 Application Process of Landscape Architecture Design Based on BIM Technology

The design methods based on BIM technology are different from traditional landscape design and the specific process is as follows (Fig. 1).

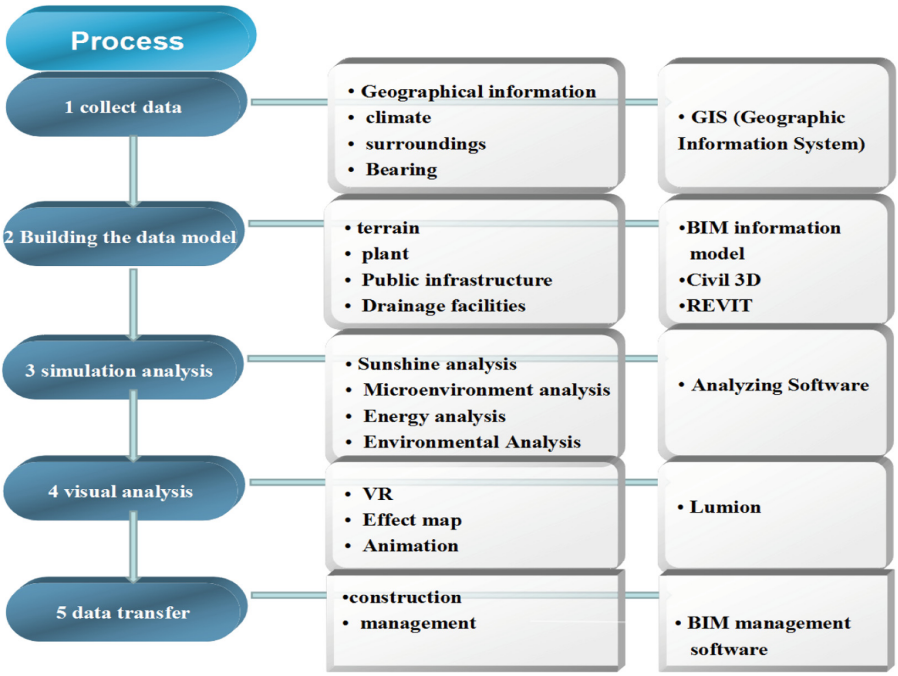

Fig. 1. Application process of landscape architecture design based on BIM technology;

- **Collecting data:** When applying BIM technology to landscape architecture design, the data that needs to be collected is plenty. Only by integrating these data into a data model, afterwards it can be fully simulated and analyzed in landscape architecture design projects.
- **Building a data model:** Build an information model library based on 3D digital technology, then oriented to BIM in the field of landscape architects.
- **Simulation analysis:** BIM's environmental analysis software has the functions of base sight analysis and base microclimate analysis.

- **Visual analysis:** Cities are existing in a complex system, so landscape architecture requires a lot of digital information to support themselves. By using BIM, the visualization of landscape architecture has a macro grasp, and scientifically guides urban development. Through visual design, some errors and deviations can be corrected in the early stages of design, and the entire process of the project can be effectively promoted [5].
- **Data transfer:** Implementation and management of 3D digital models for project design, construction, and operation using a full life cycle.

3.2 Functions of BIM for Landscape Architecture Design

- **BIM simulation.** Designers can use objects with their properties to create virtual models. For generating virtual models that can be used throughout the project life cycle, the simulation must allow modeling of critical features such as climate, heat, and motion, which enables fast calculations and more informed decisions.
- **Management of information model.** During the use of BIM, it is necessary to select and read the information of any facility in the relevant landscape design. It can be measured, identified, modified, and managed during the entire BIM application process.
- **Generation of model.** When the specified element is placed in the design BIM model, the object can be automatically generated. For example, plants can be grown along a curb line or hardened ground, or water can be automatically generated in specified areas.
- **Analysis ability.** The aspect of BIM's analytical capabilities is the ability to predict the performance of the design before construction begins. It can show how the design used or how it works in its environment in multiple ways. For example, water flow as runoff and pipeline operation, slope analysis, aspect analysis, hillside analysis, visual impact area, shading analysis, rainwater collection, parking capacity, crowd simulation, as well as vehicle simulation. These types of analysis can help the users better understand the design of assets providing more useful feedback via the development process. Analysis can also show whether the design is working correctly and identify conflicts.
- **BIM communication skills.** The communication function in a BIM project means that every stakeholder in the project who needs information can access it. Information exchange is the foundation of BIM and facilitates many other functions. For example, generating visualizations, whether static, animated, or interactive, can provide real data on assets.

4 Analysis from the Case Studies

Through the simulation of digital information, each project can easily integrate in formation to the real project while simulating and doing analyze all aspects of the project and drawing results. In this way, making a optimal presentation plan through visual animation is becoming more realistic.

In this case study, the site of this landscape design project is located at an intersection between the old and new part of a specific city. In fact, the terrain and traffic flow lines are very complicated. Because it is in the early stage of landscape architecture design, a virtual model has been used. According to different elevation points of the topographic map, the real terrain is completely simulated in REVIT including roads and buildings around this plot. The situation of the plot can be found in the 3D models. By monitoring cameras at the points of each landscape, the designer can clearly understand the relationship between the plot and surrounding buildings and roads.

After analyzing the terrain, we try to find out the problems existing in the project and how to solve this problem is the purpose.

Created a 3D model in BIM software to give relationship between the actual terrain and the surrounding buildings. Furthermore, a BIM model of the landscape design scheme was established based on the existing model as shown in Fig. 2.

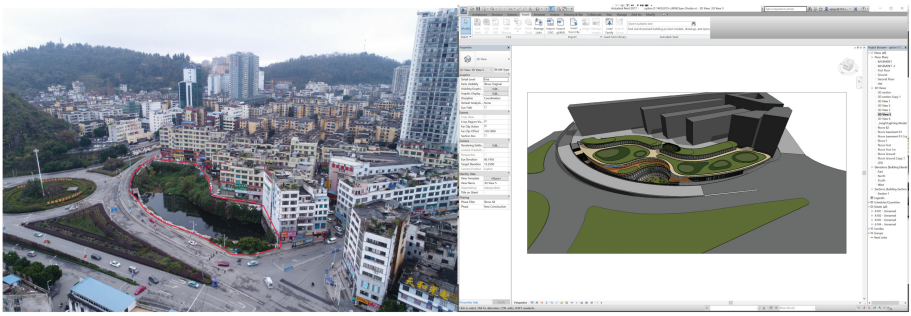

Fig. 2. BIM model.

The cameras were set up in different points and then render the model with animated demonstrations for customers. This method can help to express the designer's ideas and bring more experience to landscape architects as shown the analysis of the sightline of sight in Fig. 3.

Fig. 3. BIM model.

5 Conclusion

As a three-dimensional landscape model with information data, BIM technology can play a massive role in the entire life cycle of landscape architecture design. Digitization and information technology are the future development trends of landscape architecture design industry and construction industry. The 3D information model not only integrates the complete information of structures and landscape plants but also provides a three-dimensional communication environment. It was confirmed that the most suitable scheme design is made by using the results of simulation analysis in the early stage of landscape architecture design.

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Negative Effects of Urban Sprawl

Daniela Spirkova(✉), Andrej Adamuscin, Julius Golej, and Miroslav Panik

Slovak University of Technology in Bratislava, Bratislava, Slovakia
{daniela.spirkova, andrej.adamuscin, julius.golej, miroslav_panik}@stuba.sk

Abstract. We might perceive the suburbanization as a form of urbanization processes when it comes to the migration of population and their activities from the town to its background. The term urban sprawl is understood as a violent development of suburban areas, which is prevailingly related to the origination of large residential regions in the surrounding of large cities. Urban sprawl has many negative consequences for residents and the environment, water and air pollution, increased traffic and jams, parking. A long-term problem of the Slovak Republic is taking up arable soil for property development, especially in the field of residential projects. The factors which contributed to agriculture land grabbing are primarily caused by new housing, industrial and commercial locations as well as in the transport infrastructure. The paper points to problems of the urban sprawl of towns (on the example of the biggest city district Bratislava - Petržalka), which induce several negative effects.

Keywords: Urban sprawl · Negative effects · Agriculture land grabbing · Development projects

1 Introduction

Europe has one of the world's highest densities of urban settlement, with over 75% of the population living in urban areas. The size of many European cities is increasing at a much faster rate than their populations. This trend towards reduced population densities began in the early 1970s, most prominently in medium-sized European cities. The phenomenon of increasingly large urban areas taking up a greater proportion of the available land area is often termed urban sprawl [1]. Various studies and papers such as Peter Baus, Rastislav Krivosudsky [2], Batty, Besussi, Chin [3] and Robinson et al. [4] have documented the negative environmental impacts that can be linked to urban sprawl, while other studies (e.g. Hasse and Lathrop) [5] have discussed the increased social costs associated with the provision of public infrastructure as cities increase in size. Such impacts can be expected to have a negative effect on the quality of life of people living in European cities [1].

The occupation of the soil in favour of the town is the process, which is from the long-term point of view not sustainable as the population does not require just the space itself for living but also space for provision of basic needs for inhabitants, which the surrounding country provides [2]. Even though urban populations are barely

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reproducing themselves and migration from the countryside to the town has slowed, the demand for more living space shows no sign of abating as cities continue to expand their borders through suburban sprawl [3]. Urban sprawl is driven by demographic, economic, geographic, social and technological factors.

These include rising incomes, preferences for living in low-density areas, natural barriers to contiguous urban development and the technological progress in car manufacturing. Most importantly, sprawl is also policy driven. Maximum density restrictions, specific zoning regulations, tax systems that are misaligned with the social cost of low-density development, the under-pricing of car use externalities and the massive investment in road infrastructure contribute to this phenomenon [6].

Sprawl is perhaps the major problem facing urban planning at the beginning of the 21st century. It encapsulates the key problem of urban transportation which revolves around the emphasis on the car as the dominant means of movement and it reveals the way different social and income groups polarise and segregate themselves from one another [3].

Political and economic reforms in the 1990s have had important effects on city transformation in Central and Eastern Europe. In the urban context, the reintroduction of land and housing markets in post-socialist cities have been the main effects of transition reforms [7].

After 1989 also Slovakia, as well as the other Eastern and Central European cities, had to face the massive de-industrialisation – a rapid structural chance which they must master. Consumption and production patterns have been rearranged. Multinationals fought over future market shares in the region, strategically developing hypermarkets and other big-box retail stores on Greenfield sites along major access roads, thus increasingly fostering a culture of automobile-dependent consumerism. The privatization of the housing stock is a central planning problem in the cities, as also the transportation and environmental consequences of urban sprawl are.

A sophisticated system of property prices has developed, reflecting the location, quality, size, accessibility and level of service city areas. Property prices in capital cities are often 30–50% higher than in other cities. The price increase is the most significant in attractive inner-city locations and some residential areas at the city outskirts, showing the sharp difference between the city centre and peripheral areas (see also Struyk [8], Hegedüs et al. [9], Pichler-Milanovic [10]. However, at present the urbanization is not characterized just with the city growth, growth in the number of inhabitants and dynamics of capacities for living, but also processes influencing the surrounding agricultural country. According to Antrop [11] the present changes of the landscape structure influenced by urban processes, the result of which is the residential and industrial development of the area and creation of new infrastructures.

Several authors present the research on urban sprawl, e.g. Brueckner [12], Nechyba and Walsh [13] and Anas and Pines [14]. Urban sprawl is standardly characterized by multidimensional phenomenon, which is conditioned by many processes and which leads to non-effective utilization of soil sources. Urban sprawl is observed globally, even its properties and impacts vary [1].

This paper aims to present negative aspects of the urban sprawl in the capital city of Slovakia Bratislava on the example of the biggest city district “Petržalka”.

2 Methodology and Materials

In the paper the authors drew mainly from the theory of urban sprawl as: Anas, Pines [14], Antrop [11], Baus, Krivosudsky [2], Batty, Besussi, Chin [3], Hasse, Lathrop [5], Halas, Dzupinova [20], Ourednicek [17], Pichler-Milanovic [7, 10], Robinson, Newell, Marzluff [4], Sveda [18], Nechyba, Walsh [13], Sveda, Podolak [19] etc.

The combination of several scientific methods and approaches (analysis, abstraction, synthesis, deduction, comparison) were used for the elaboration of the issues in the paper. The important sources of data were scientific literature devoted to this issues and research reports OECD Rethinking Urban Sprawl: Moving Towards Sustainable Cities (2018), a database of the Slovak statistical office, the Land Register Office SR Another knowledge was gained in personal consultations and by the method of brainstorming with professionals and scientific workers in the field of spatial planning and the real estate market from Slovakia, the Czech Republic, Austria, and Poland.

3 Problem Identification

Urban sprawl or suburban sprawl is related mainly to unlimited growth in several city districts of housing, commercial development and routes on large land areas [15]. In Slovak (post-communistic) towns these processes were in the era of real socialism significantly slowed or even stopped [16]. Up to the beginning of 90ies, Years of the 20th-century suburbanization was limited with several barriers (non-existing market with plots, lack of private capital etc.) which made the development of suburban housing impossible (more detailed, e.g. Ourednicek [17]). Despite the existence (or more visible manifestations) of this phenomenon in the Slovak surrounding just in less than two decades, we might observe the first impact of suburbanization on the social and physical surrounding of suburban country of big Slovak towns, especially in Bratislava (e.g. Sveda [18]. One of the most serious impacts is the shrinkage of arable land, the price of which might be up to 100-times lower than the price of building sites. A critical situation occurs especially when it comes to the irreversible damage of socially valuable grounds (for example elimination of vineyards in the surrounding of Bratislava. Sprawl is directly identified with urban growth. As cities get bigger, they clearly have to expand around their peripheries for it is much more difficult to increase central densities. Urban sprawl has many negative consequences for residents and the environment, water and air pollution, increased traffic and traffic jams, increased car dependency, parking, etc.).

4 The Case of Petržalka, the City District of Bratislava

The functional area of Bratislava, as the capital city of Slovakia, went through several changes in the properties of its structure in recent decades. The development of the area was and is marked by intensive, prevailingly housing construction. One of the primary

reasons of the expansion of the urban district is just the effort of mainly young families to find a financially acceptable housing in the nearness of a town [19].

Petržalka was one of until that time rural villages, which were in the year 1946 affiliated to Bratislava (villages Devín, Dúbravka, Karlova Ves, Lamač Petržalka, Prievoz, Rača and Vajnory). The intensive construction on the right bank of the Danube in Bratislava - Petržalka started after the year 1976 (Fig. 1) due to the depletion of suitable close (and large) localities to the city centre of Bratislava. The plan was to create a housing estate for more than 100 thousand people. The construction of this complex was also linked with the redevelopment of the existing housing stock. More than 1500 houses, in which approximately 6000 inhabitants lived were redeveloped. Just the north-west part of the area stayed in the original condition - family houses in the direction to the border crossing Berg and the housing estate Matador with 400 flats, built in the era of 1967–1970.

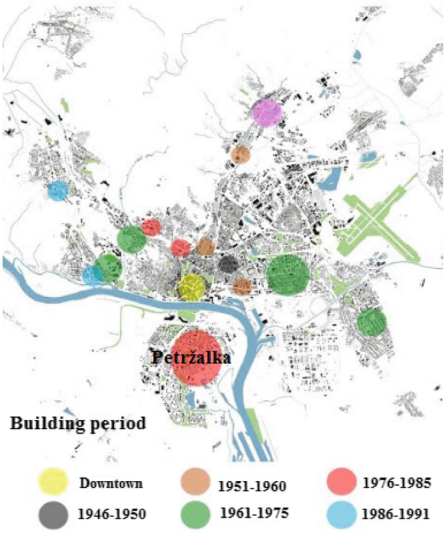

Fig. 1. The intensive construction on the right bank of the Danube in Bratislava - Petržalka started after the year 1975. Source: [20]

The scope of construction in Petržalka (40 thousand flats) was unusually large in the frame of the whole Czech-Slovak Republic. The high-rise level of buildings was prevailingly on the level of 8–12 floors, in the direction to the recreational areas and playgrounds the number of floors lowers to the level of four floors. The possibility of choice of the types of residential buildings narrowed to the small number of terraced and single houses of housing character, which did not allow the creation of urban spaces. So, it becomes one of the newly originating city parts where larger residential complexes (housing estates) originated [20].

Bratislava urban district Petržalka is the most densely populated part of the capital city, where up to 24% of all inhabitants of Bratislava live. Since the year 2000, the

housing construction in this urban district has become intensified, and this urban district started to spread in the southern direction Fig. 2.

New developer projects originate, which induced several negative effects:

- increase in the number of inhabitants and cars,
- migration flows to Bratislava,
- agricultural land grabbing.

4.1 Increase in the Number of Inhabitants and Cars

Out of the number of Bratislava inhabitants (432 864) almost 104 thousand inhabitants live in the biggest urban district - Petržalka. The increase in the number of inhabitants also increased the number of cars, almost by one quarter, which in the absolute expression, is in the volume of more than a quarter of million. The survey of parking and transport in the urban district of Bratislava - Petržalka (2018) also points to the fact, that daily 132 thousand of vehicles passes through this urban district, out of 50 thousand vehicles as transit, which has the negative impact of the air cleanliness.

At night in this biggest urban district, 34 000 cars park there on average, out of them 26 000 on the official parking places and 8 000 outside of them. The data from the multiple counts of cars in Petržalka done by its municipality in 2018 at night showed it.

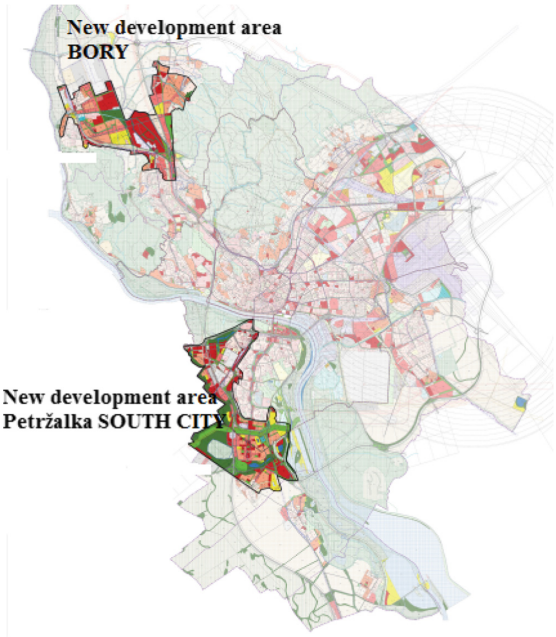

Fig. 2. New development areas of Bratislava - BORY and Petržalka SOUTH CITY. Source: authors

4.2 Migration Flows to Bratislava

The capital city Bratislava is at present not only the most attractive area but also part of the richest region of Slovakia, to which the migration flows are still directed. At the same time, it has the highest work offer and provides a wide range of opportunities for study. This fact also causes high migration flows to Bratislava (or Bratislava region) either as daily or weekly mobility or moving. The analytical data of population Big Data and Market Locator from mobile phones located in the capital city confirmed it [21, 22]. It needs to be emphasised that Bratislava has a specific position in the migration system of Slovakia.

4.3 Agricultural Land Grabbing

The long-term problem in the Slovak Republic is agricultural land grabbing with the aim of big development - the construction of industrial, administrative and primarily residential projects [23]. In less than ten years, Slovakia lost about 67 thousand hectares of arable soil, and foreign investors bought another 40 up to 100 thousand hectares of soil. The consequences of uncontrolled building boom manifest in agricultural land grabbing for the construction of development projects as well as subsequent forming of negative externalities. As the negative trend (negative externalities) can be considered extensive building - suburbanization, urban sprawl. Suburbanization and urban sprawl consume parts of the country, which could be used for example as agricultural land or forest. With that the natural environment is losing its ecological function.

5 Conclusions

Building boom in the Slovak Republic in the last 15 years has caused several serious problems. This is particularly the failure of the State administration to manage development activities. Building authorities are under pressure from rich development companies, causing great damage for violations of land use plan. Determining factor which significantly influenced the expansion in the real estate market in the Slovak Republic was the fact that after the year 1990, the agricultural soil was given to original owners. Many owners decided to earn quickly and to sell agricultural soil to developers with a high profit. The consequence of the sale of agricultural soil in the recent century was the fact that just foreign investors bought more than 100 thousand hectares of agricultural soil, which significantly contributed to the permanent decline in the volume of agricultural soil, the urban sprawl of towns and so the creation of negative externalities. Land management in the country becomes a limiting factor for sustainable development.

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Revival of Rågsved Valley: An Exploration in Introducing Human Factors in Sustainable Urban Planning

Shiyao Qin, Zhenyu Gu(✉), and Dong Wang

Shanghai Jiao Tong University, Road Dongchuan. 800, Shanghai, China
{shiao.qin, zygu}@sjtu.edu.cn

Abstract. This essay is about how to restore the balance in a wasted area using environment friendly ways, as well as engaging local people to participate in this process. We carried out research about the current situation to figure out problems that need to be solved and the attitude and demands of local people towards their community. Based on the research findings, we propose a reconstruction plan, basically a wetland park with a 4H farm, using phytoremediation to help reform the ground, using actor–network theory to engage all stakeholders to provide a vision for the reconstruction of Rågsved.

Keywords: Sustainable urban planning · Human factors · Phytoremediation

1 Introduction

The idea of sustainability is gradually becoming the common agreement in human society [1], while leaving how to introduce human factors to the process of urban planning becoming an interesting topic. Rågsved is an area located on the south of Stockholm, Sweden, characterized by large-scale rift valleys and small hillocks, where the different habitats merge into each other and form a rich biodiverse landscape. The area has been inhabited since the stone age, and there are traces of farms that date back to the 1700 century [2]. Rågsved was initially considered to be a modern and attractive neighborhood, until the 1970's industrially produced residential houses were built in the northern part of Rågsved followed by a rapid decrease of the area's reputation.

Kräppladalen, one of the largest valleys in Rågsved, showed in Fig. 1, was constructed in the 1870s to be a usable grassland. A 900 m trench was built for dealing with stormwater from nearby residential areas in 1950. In 2007, two treatment ponds were built, a portion of the trench got a meandering course, which is the situation today [3]. Considering the contaminations and flooding of this area, the idea of reconstruction was brought by the Stockholm Municipality to make the area more sustainable and become popular again.

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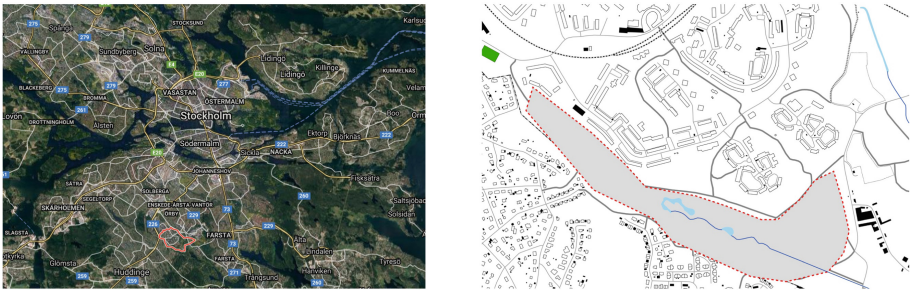

Fig. 1. The left one shows the location of Rågsved in Sweden. The right one shows Kräppladalen and its nearby residential areas. Kräppladalen is a valley in Rågsved, which is outlined by a red dotted line. Two blue blocks are the ponds.

2 Field Research

Researches were conducted mainly in two aspects, contaminations and local people activities. About the former, we basically used the literature research method, while applied the method of observation and interview in discovering the relationship between the local people and the environment.

Contaminations. We figure out the boundary of the area where might have been the shooting field [4], within which there are still military remains from World War II. We also map the area where flooding might cover in different incidence (Fig. 2).

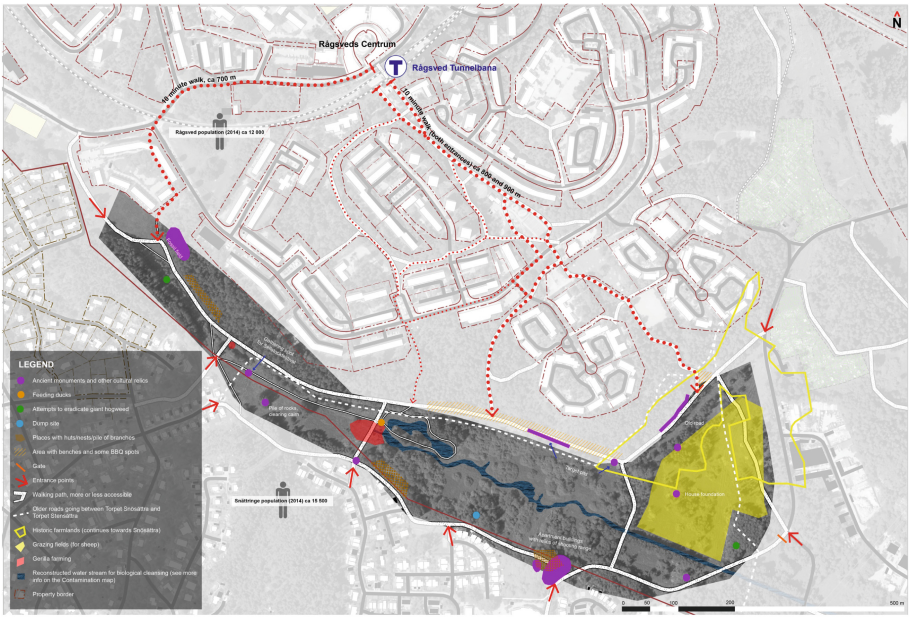

Fig. 2. Human activities in Kräppladalen.

Human Activities. Though Kräppladalen is not popular as it used to be, there are still many human activities taking place in this area. According to our investigations, We find that there are places within this area where people feed ducks and have BBQs. Also there are ancient monuments and other cultural relics, as well as dump sites. There are people from time to time jogging and walking their dogs along the walking path around Kräppladalen. By examining the sites and neighborhoods, we figure out all the entrances connecting our site and the nearby residential area. From the investigation above, we can easily tell that Kräppladalen is part of the lifestyle of local people. Results from a later survey prove that. We did a survey of people in the Facebook Rågsved - Anslagstavlan showed that the majority of people - when asked what they like most about Rågsved - is the nature. Also they appreciate the recreational opportunities and the walking paths. Quite a few people did not know about Rågsved friområde - however many people mentioned it as their favorite place in Rågsved, and say they use it for various recreational purposes. Finally, this survey also showed what people miss in Rågsved, for example a ski track, better running tracks, outdoor gym, youth activities and outdoor activities etc. We also had two interviews with local people, one is a headmaster of local primary school, another one is a stuff in the café in Nya Rågsved Folkets hus. The Former said that it is vital for the children to have access to the nature and Kräppladalen could have been a perfect place. He mentioned that farms are popular destinations for students' school trips, which can teach children knowledge about plants and animals, as well as bring them joy. The latter said that there is a need for more places dedicated for children and elder. She also suggested that Kräppladalen should be built with more places and equipment for outdoor activities to enhance the well-being of the community (Fig. 3).

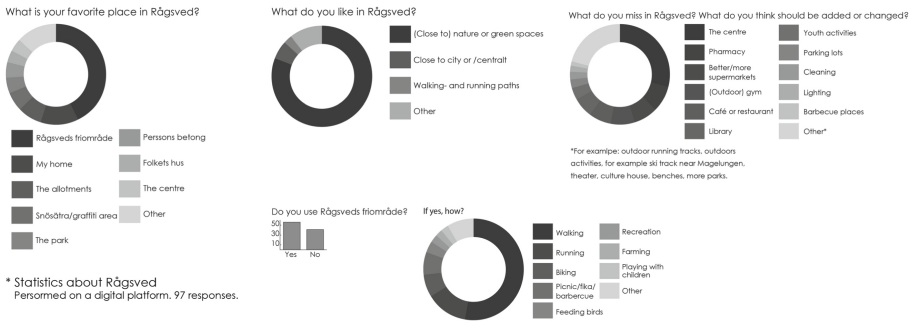

Fig. 3. The results of a survey to the people in Rågsved about their attitudes and feelings towards their hometown and Kräppladalen.

All these are inspiring that we thought it was important to take into consideration. So we have mainly try to preserve as much as possible of the nature area and instead tried to boost these qualities even more and develop the area so that it can hold more activities and be a healthy and vibrant nature area.

3 Methodology

Phytoremediation. To exterminate metal pollutions and maintain the water quality, phytoremediation could be a useful method. Phytoremediation is defined as the use of green plants to remove pollutants from the environment or to render them harmless [5]. According to research, mycorrhizal fungi were found to play an important role in heavy metal detoxification and the establishment of vegetation in strongly polluted areas [6]. Aquatic plants can also be helpful in accumulating and concentrating heavy metals [7]. So when we made proposal for the revival of Kräppladalen, we decided to cultivate mushroom and tall fescue in certain areas to help eliminate the contaminations (Figs. 4 and 5).

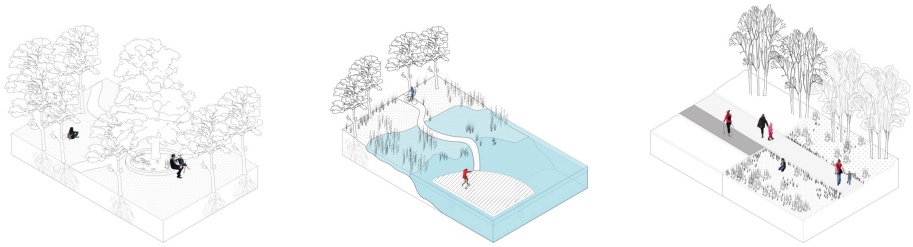

Fig. 4. Detail designs for phytoremediation. The first picture shows that mushrooms are surrounded by the concrete circle bench. Trees can provide shade for mushrooms. The bench can provide space for people to stay and relax. The second one shows that how we redesign the water system that can vary according to the change of seasons even the weather. The third one shows that the same spot in winter and summer. In winter, while everything is covered by the snow. In order to make full use of our area. We propose to create a small path for people skiing during winter and when it's summer, it can be kind of meadow to provide space for people to relax and enjoy the sunshine.

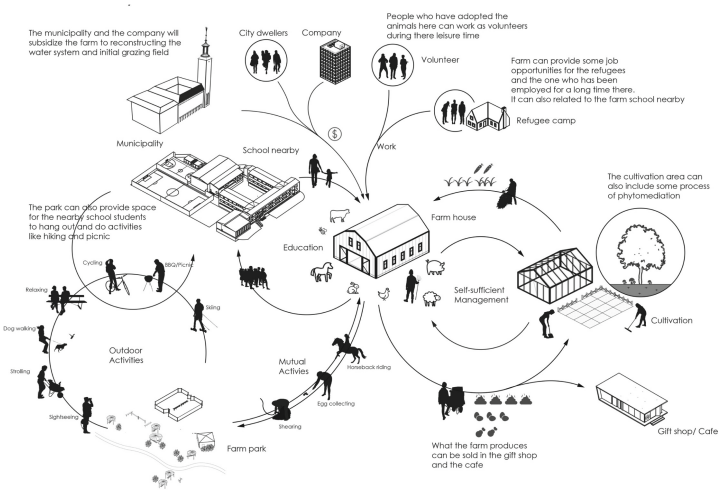

Fig. 5. Applying Actor–network theory to engage all the stakeholders to participate in our 4H farm.

4H-Farm. What's more, these plants can be harvested for the 4H-Farm, another proposal we made. 4H means head, heart, hand and health, a concept popular in Sweden. There are 37 4H farms across Sweden, 11 of them are in Stockholm county [8]. However we saw that they're unevenly spread and exist mostly in the northwestern parts. A 4H farm in Rågsved, close to the Huddinge border, would become a nice addition to the south of Stockholm. 4H farms are destinations for study trips from schools both serve leisure activities for children and could also offer work opportunities.

Actor–Network Theory. Considering the elements mentioned above, Actor–network theory method [9] is applied to define and organize the actors related to the farms to ensure the farm to be self-sufficient and ecologically friendly. The farm may get financed from the municipality, the company and the individuals who are willing to adopt the animals to become members of the farm. The workers can be volunteers and the refugees from the refugee camp nearby. The plant growing in the cultivation area can be used as food for animals and the waste of the animals can be used as manures for the plant. The farm can make profits by providing activities such as shearing, egg collecting, horseback riding for the visitors and by selling farm products like fresh eggs in the gift shop or the Rågsved market. To adapt to the activities mentioned above and create more sports and leisure areas for locals, we reconstruct Rågsved valley by proposing a new water system as well as playgrounds and walking paths, etc.

4 Proposal

Based on the findings, we propose a plan for Revival of Rågsved with three aims:

Find a way to keep the nature healthy and thriving, and also working with maintaining a good water quality; Create work opportunities, as well as strengthening the economic system of Rågsved; Create better connections of the areas surrounding the site, providing a better place for local people to have outdoor activities.

Figure 6 are thematic layers and Fig. 7 is the proposed isometric view drawing for Kräppladalen. We propose a new water system that the water level can vary according to the change of season and weather. We design two borders for the water which can help to increase its ability to obtain more water and it is also good for the process of phytoremediation. Since the water is flowing more slowly, by planting on the river banks, we get more chances to clear the water before it flows into next area. The yellow hatches in the fourth layer represent the area where we are going to keep the animals and the green ones represent the cultivation areas. And in order to make our farm more accessible and more like a park, we redesign the path system by adding more pathways and placing some round squares above the water. We also propose a skiing track as a response to requirement that they need more space for outdoor activities and make use of Kräppladalen in winter time. In this isometric drawing, we want to show the situation and stories will probably occur in the farm one day in the future. According to our concept and expectation, the farm will certainly be popular for people gathering and visiting.

Fig. 6. Five layers showing our strategy. From left to right, they are illustrations for existing water system, proposed water system, existing contamination, proposed farmland.

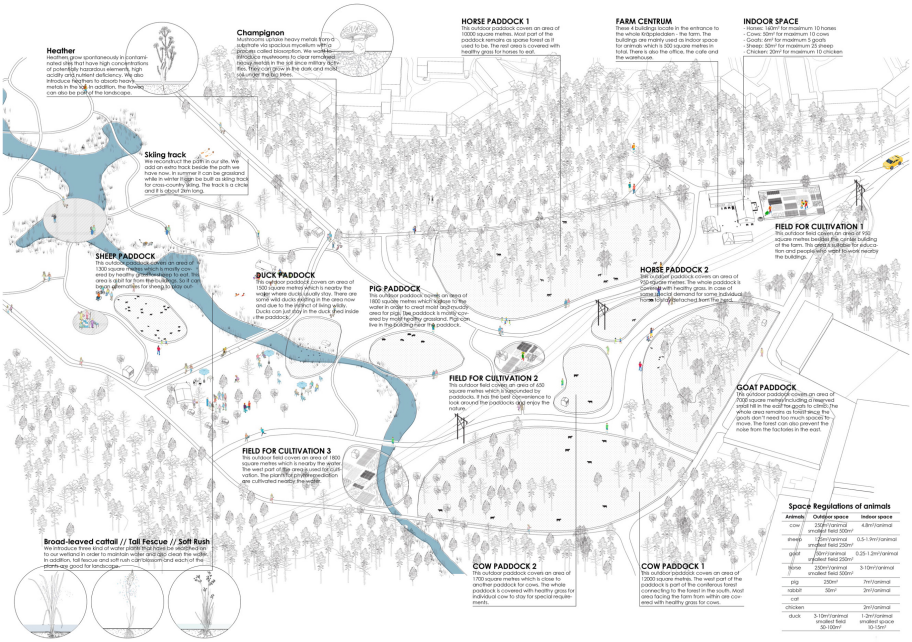

Fig. 7. Isometric view of our proposal that basically shows the situation and stories will probably occur in the farm one day in the future.

5 Conclusion

Our work is an exploration in urban planning areas of how to introduce human factors to the damaged environment by using environment friendly ways. We are trying to take human factors, phytoremediation and urban planning into one practical case to research a stage where human can enjoy nature, while nature gets helped from human activities, and finally present a prosperous community. Our work was presented to the Stockholm municipality and local people, which turns out to be quite popular and inspiring for the later actual reconstruction of this area.

But there also exists some problems that need to be discussed further. This research and design are practices in a more general way and we neglected many details when make our proposal. And when it comes to actual reconstructions, it definitely needs much more strategies. Like the use of phytoremediation, it would be more scientific and instructive if we can do more quantitative researches.

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Research on Branding of Historic Cities Under the Background of Social Change: A Case Study of Suzhou

Shan Huang(✉)

International Center for Innovation Design, SJTU (ICID-SJTU) Master Student, Shanghai Jiao Tong University, Shanghai, China
sharon.h@sjtu.edu.cn

Abstract. Suzhou, a historic city located in the Yangtze River Delta region, with rapid economic development, is facing challenges and opportunities in building its city brand. From the perspective of social change, using the methods of questionnaire survey and in-depth interview, this paper tries to study the brand image of Suzhou city in different periods through the viewpoints from local respondents of different age and background to come up with and analyze the problems encountered by current Suzhou city brand image building, proposing creative strategies and thinking.

Keywords: City image · City branding · Social changes

1 Introduction

With the further development of economic globalization, the urbanization process in each country is accelerating. Furthermore, the competition between cities has also intensified. At the sometime, the problem of urban homogenization of armored concrete and heavy traffic has become more obvious and relatively prominent. If a city wants to thrive for a long run, a good image is necessary. Therefore, how to utilize the city's natural and social resources, and find the connection between city's spiritual civilization and modern material civilization, so as to create an unique brand image of different city has become an issue which always receives high attention from each nation.

Based on the local culture and establishment of the city brand image, city brand fully exploits the various resources of the city, and gathers the natural resources and the essence of humanistic creation of a city in a highly concise form, reflecting the personality and soul of the city. The city brand is a precious intangible asset of the city, which can improve the sense of belonging and pride of citizens, and can also improve the city's social popularity, reputation and the core competitiveness. With the development of China's opening up to the world, more and more cities are gradually realizing the importance of urban brands to urban development and try to build up their own urban brands. "Run a city like a brand" has become a consensus of the society.

Located in the Yangtze River Delta, Suzhou is a famous historical and cultural city with beautiful scenery and pleasant climate. It is known as the "paradise on earth". And

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also, famous as "Venice of the East" for the waters of 42% of the total area and the crisscross river network in the city." In addition to the numerous bridges, there are also art gardens that combine artistic techniques with artificial mountains, bridges and flowing water. It has been awarded the Best Habitat Model Award, National Environmental Model City, China Excellent Tourism City, Garden City and other honorary titles by the United Nations, which has greatly enhanced the brand image of Suzhou City.

2 City Image and City Branding

City image is a combination of the external macroscopic material and the inner microscopic spiritual image. It is gradually formed through social activities such as urban production, life and interpersonal interaction under the background of the city's natural conditions, historical evolution and cultural origin. It is the condensation and embodiment of the historical and cultural heritage.

The city brand is the refinement and sublimation of the city image. It is an abstract summary of the city's historical heritage and spiritual characteristics, such as Paris, which also named the "Fashion Capital", Venice, the "Water City", Vienna, the "Music Capital". Professor Kevin Lane Keller of Duke University in the United States defines the city brand in his literature named "Strategic Brand Management": geographical location or a certain space area can also become a brand, just like products and people. The power of urban branding always pushes people to learn more about a certain area, and connect this imagination and association with the existence of the city, so as to let its spirit blend into every building in the city, and make the competition and life coexists with the city.

3 Methods

In the field of sociological research, social change refers to changes in various components of society and social systems. In terms of macroscopic aspects, it includes changes in social forms, stratum structures, occupational structures, and social organizations. In the case of microscopic aspects, it includes changes in behaviors, values, and lifestyles. This paper uses a combination of online questionnaires and in-depth interviews to try to get their impressions of Suzhou city brands from different age of groups, and analyze them longitudinally in time dimension to confirm the influences of social changes on Suzhou city brands.

In this study, 104 valid online questionnaires were collected, and four representatives were interviewed in depth (A-local resident in Suzhou, B-temporary resident in Suzhou, C-Suzhou local resident in Shanghai, D-resident in Shanghai).

In 1991, D. Aaker, a famous American brand management expert, proposed a concept named "five-star" model of brand equity, that is, brand equity is constituted by brand awareness and perceived brand quality, brand association, brand loyalty and other brand-specific assets. In this study, the research on 'brand awareness', 'perceived brand quality' and 'brand association' in the above models was conducted.

4 Results and Discussion

4.1 Brand Awareness of Suzhou

Brand awareness refers to the degree that the brand is known to consumers, also known as brand popularity. It reflects the scope or breadth of the brand's influence. The comparison between urban brand awareness can explain the extent to which different cities are known to people. As shown in Fig. 1, brand awareness of Suzhou is relatively lower, compared to ten cities along the eastern coast.

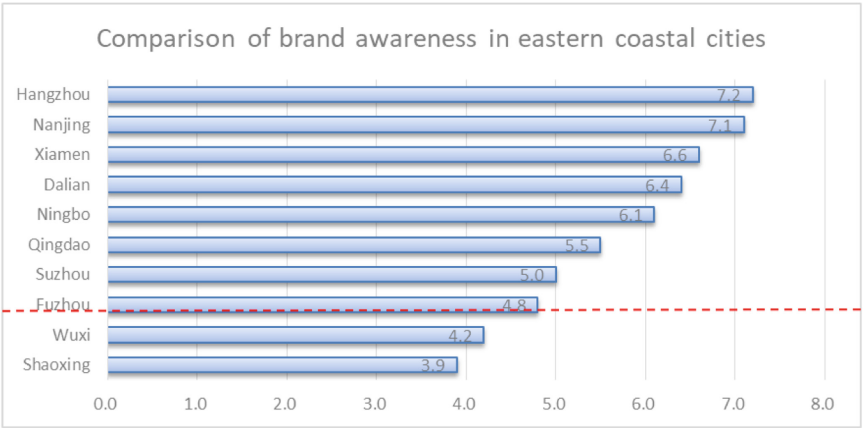

Fig. 1. Q: Assuming that the Suzhou's popularity worth 5 points, how many points will you give to other cities?

> *"I am a native. I feel that Suzhou's reputation is not as big as it used to be. There used to be an old saying about goods produced in Suzhou ' it's broken, but it still works '. This sentence means that the previous Suzhou goods is durable and famous, even if It is broken, whose popularity equals to goods in Hangzhou, Nanjing, Ningbo in that time, but in recent years, Suzhou's reputation is not as fabulous as before."*
> *- In-depth visitor A-local resident who lives in Suzhou for a long time.*

If combined with the age level of the respondents, as shown in Fig. 2, it will be found that the respondents who were born in the 1950s rated the city brand awareness in Suzhou significantly higher than in the 1990s. The reason is mainly due to the lack of tourist destinations at that time. The state-owned enterprises selected Suzhou as a must-see for spring and autumn tours, and the "series" activities during the Cultural Revolution. Most of the respondents in the 1950s went to Suzhou. Impressed by the city. In the 1990s, young people's tourist destinations were very rich, and Suzhou was no longer the only option. Therefore, the changes in occupational structure, social organization and tourism style have had a significant impact on the brand awareness of the city.

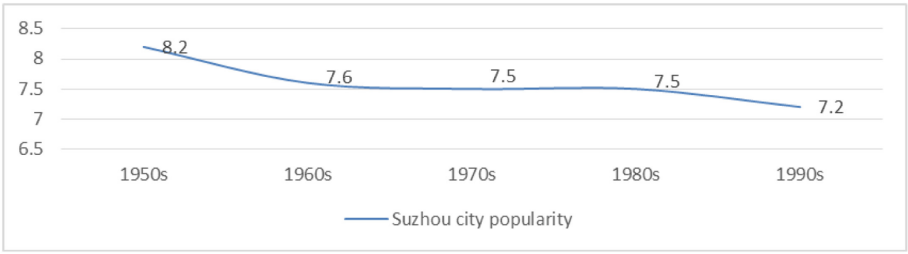

Fig. 2. Q: Assuming that the highest score is 10 points, please score Suzhou's city brand awareness in the range of 1–10 points.

4.2 Perceived Brand Quality of Suzhou

In the field traditional view on consumption, perceived brand quality represents customer's understanding level on brand, and it also related to the depth of the consumer experience. It is a kind of perceived brand quality that is gradually formed after the audience's acceptance of brand communication and usage of brand's products and services for a long time. Nevertheless, The brand awareness degree of urban brands is reflected in the city information and abstract spirit, which will be condensed into typical urban image symbols by static or dynamic methods, at the same time, perceived and recognized by the receiver, such as the Statue of Liberty to New York, the Oriental Pearl Tower to Shanghai, the Eiffel Tower to Paris, and more.

As shown in Fig. 3, when asked about the sort of things that best represent the characteristics of Suzhou city, Suzhou Garden is a representative that can be accepted by all ages. However, the other things show great differences, which stands for distinct features of social changes. Respondents born in the 1950s and 1960s prefer the traditional cultures such as Pingtan, Kunqu and embroidery. The interviewees in the 1970s and 1980s agree with jade carvings, cheongsams, golden chicken Lake, etc. The interviewers are more different and believed that the Suzhou Central Building is commonly known as the "big pants", is more representative of the image of Suzhou. At the same time, They also highly recognize the new landmarks, Lake and Yuanrong, and are more interested in various Suzhou cuisines.

> *"I feel that the characteristics of canal town in south of the Yangtze are not unique to Suzhou. I went to Zhouzhuang, Luzhi, Xitang, Tongli and other ancient riverside towns and discover that they are almost the same to Suzhou Gardens. Now I can't think of the differences between those attractions. For a layman who does not specialize in landscape design, they are all some. Undoubtedly, the big pants, which lies in the center of Suzhou and stands high by the Golden Chicken Lake, is the unique Symbol Suzhou…"*
> *- In-depth interviewer B-foreigners temporarily living in Suzhou.*

On the bank of golden Lake in Suzhou Industrial Park, a modern sculpture engraved with the character "circle and melt" is a distinctive symbol of Suzhou's social changes. It shows "fusion and symbiosis between tradition and modernity, technology and humanity". Suzhou is a city where tradition and modernity integrated and blended. With the establishment of the Suzhou city brand, many people think that this is a good interpretation of the urban spirit of Suzhou.

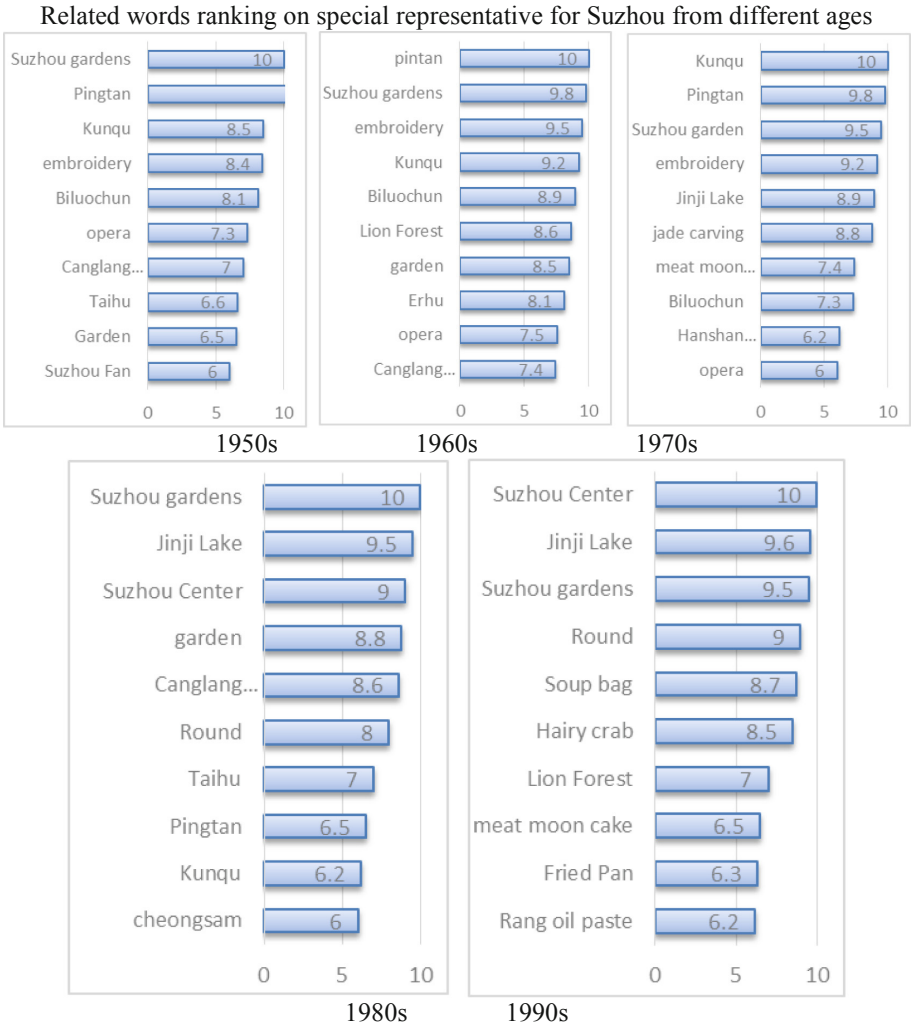

Fig. 3. Q: the order of most special things that represent Suzhou

"When I see the logo of the Oriental Pearl, I immediately think of Shanghai, but if I see a sign of a pavilion, a rockery or a cave door, I know it is a garden in Jiangnan, but I will not immediately recall Suzhou. This shows that Suzhou is still lack of an obvious city symbol." In-depth interviewer C-Suzhou people who lives in Shanghai.

Related words ranking on special representative for Suzhou from different ages.

4.3 The Level of Brand Association in Suzhou City

Brand association is kind of awareness that can be triggered from customers' memory when they see a particular brand, including feelings, experience, evaluation, brand

positioning, etc., and these ideas may come from daily life in all levels, such as: their own experience, friends' word of mouth, advertising information and various marketing methods. For city brands, each of these different sources mentioned before may form a deep-rooted brand image of the city in people's minds.

Related words ranking on impression of Suzhou from different ages.

As shown in Fig. 4, when you are asked about the name of the city named "Suzhou", what is the first related word or phrase flashed in mind, except for " Canal Town in south of the Yangtze", is the consensus of respondents from all ages, but other words show large differences. Respondents in the 1950s and 1960s recalled a green, clean environment and the laid-back attitude to life. Respondents in the 1970s and 1980s recalled the world factories, developed economies, and cheap housing prices. Respondents were concerned about the temperament of petty bourgeoisie, food and other entertainment situations.

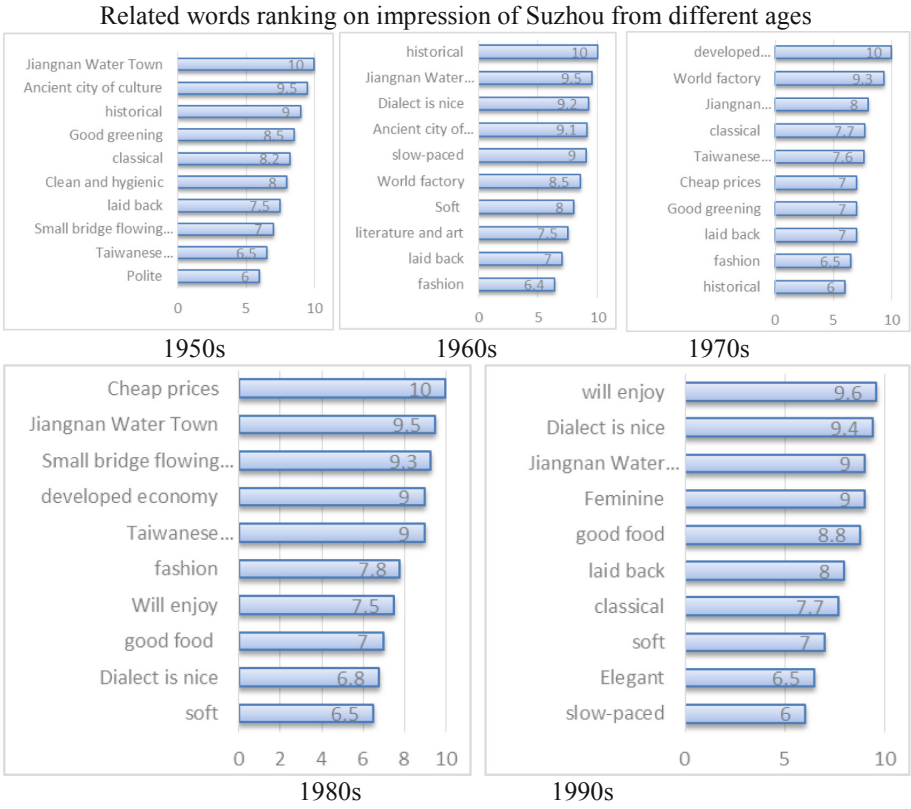

Fig. 4. Q: when it comes to Suzhou, what is the first words in your mind?

" For Shanghainese, there are several impressions on Suzhou. One is that Suzhou is the must place where you visit graves every year, because the family cemeteries are all in Suzhou. One is cheaper, and the price is less than a third of Shanghai. Many Shanghainese goes to Suzhou to

speculate houses. For example, many real estates in Kunshan, Huaqiao, are bought by Shanghai people; there is also an impression that Suzhou dialect sounds sweet and soft. That is why people always say they would rather quarrel with Suzhou people than talk to Ningbo people."
- in-depth interviewee -D -an outsider who lives in Shanghai.

5 Conclusion

City brand is also a kind of productivity, which mainly embodies in coordinating the progress of urban construction, economic development, industrial layout, cultural causes, public services and other fields with a unified value orientation, and then achieve the effect of focusing on advantages, gathering elements and gathering popularity. Finally, it wins the favor of investors, entrepreneurs and tourists at home and abroad, and injects vitality and activity into urban development.

The core of Suzhou city brand should be "world famous cultural city". For a long time to come, Suzhou should concentrate on building a world-famous cultural city with strong economic strength, typical water ecology as its foundation, unique historical culture as its endowment and legal society and harmonious society as its guarantee.

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