




# Fernando Higuera, Expansive Geometries through Models

Noelia Cervero Sánchez<sup>(✉)</sup> 

Escuela de Ingeniería y Arquitectura, University of Zaragoza, Zaragoza, Spain  
ncervero@unizar.es

**Abstract.** The architect Fernando Higuera (1930–2008) displayed great expressive abilities through his scale models during the first decade of his professional career. They allowed him to develop some principles of formal generation that stemmed from geometry, which would become invariants in a continuous evolution. The analysis of these scale models brings these geometric principles closer; they start from order and structural clarity while bringing an expansive character to spaces and forms. The geometric rigor of the first models, with modular sequences of folded planes or linear elements, gave way to multiple symmetries and surfaces of revolution with radial structures, which culminated in the proposal for *Ten residences for artists in Monte de El Pardo* (1959). It began the conjunction of these three-dimensional geometric models that, using folding, aspired to an unlimited growth of the form, with an organicism, or adherence to the natural environment and historical roots, and a biomorphism, or formal relationship with biological organisms. This spatial intention gave rise to a continuous discourse that culminated in the *Multipurpose Building in the city of Montecarlo* (1969), whose living and organic presence found the best way of expression of its expansive geometry in the scale model.

**Keywords:** Fernando Higuera · Geometry · Scale models · Creation · Nature

## 1 Introduction

Scale models constitute a sculptural and intentional vision of the architectural work, a first construction of the work. In his early years, scale models allowed the architect Fernando Higuera (1930–2008) to shape his artistic personality through the language of geometry in a series of unbuilt projects, which brought him a large number of awards and, have become part of our collective imaginary. Individuality as a determining feature of the architect's expressive capacity, with an expansive, infinite personality (Ábalos 2008), guided a formal generation that evolved around the concept of beauty, conceived from the function, balance, rhythm and geometric structuring of the form. As stated by Higuera himself (Castro Arines 1978, p. 30) “Of course, I make the model and the Project, but I often make the model first as a sculpture”. He worked with scale models to achieve the expression of the projects but at the same time discovering their constructive and architectural logic (García Ovies 2020). His conception of architecture is not only attached to the geometric concept, but also to the symbolic form, to the form

par excellence as Hegel called it (Chueca Goitia 1971, p. 39), defined from the construction that constitutes its essence or genesis.

This system of work helped create during the first decade of his career an important legacy of scale models that, allows us to analyze how his geometric principles, order, compositive and structural clarity, highlighted by Alberto Humanes (Higuera 1997, p. 11), bring an expansive character to spaces and forms.

## 2 First Approaches

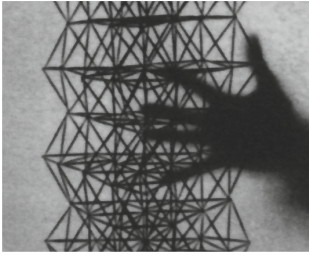
At a time of renewal of Spanish architecture, of generational change with new strategies around the integration of the arts, and committed to the recovery of the avant-garde, Higuera made his approach to the concept of the project from the plastic experience. His conception of space stemmed from an attitude both emotional and spiritual, which Giedion (1999, p. 21) attributed to contemporary architecture, developed in the sixties. He considered it alien to the independent form and linked to the spatial relationship, the conception of space-time and respect for the immutable conditions – cosmic and terrestrial – of the environment, which he called 'new regionalism'.

In this sense, the deeply intuitive character of Higuera, with an outstanding activity in disciplines such as drawing, painting, music and photography (Botia 1987, p. 7), provided him with various expressive resources and relationship with the form, which has distinguished him over time (Navarro Segura 2001, p. 5–6). However, as Carlos Flores pointed out when he published the first projects in a monographic issue of the journal *Hogar y Arquitectura* in 1962: “if at first glance it might seem that his work is dominated by an eminently plastic sense, a closer study demonstrates the concerns of all kinds behind some forms whose suggestive power seems to turn them into protagonists of the architectural fact”.

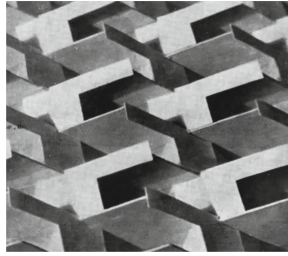
In the project strategies of Higuera, the spatial organization gives way to models (García German 2015), in which he fit the program together using a repetition of resources and an organization of elements, which appeared very early in his work and evolved with the same determinants. His process of creation from volumetric and spatial studies can be seen in the scale models of his college years (1954–1959), which start from open systems and go on to delimit specific spaces.

Among the scale models that define open systems are those made for a *Project for a Monumental Fountain or Obelisc in Castile square in Madrid*, 1958, in collaboration with Julio López Hernández, through a three dimensional assembly of linear elements (Fig. 1), or for the *Collective housing Project*, made during the fifth course at Madrid School of Architecture, 1958, using a modular sequence of folded planes (Higuera 1969) (Fig. 2).

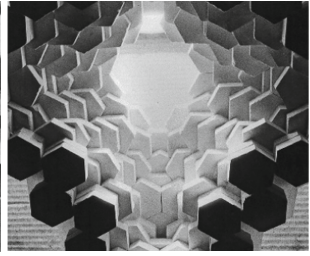
The interest in modular systems, ruled, from the repetition of a single element led him, for the delimitation of specific spaces, to the use of multiple symmetries, such as the one he explored in his Final Degree Project, a *Chapel in a Military Cemetery*, 1959, composed of hexagonal prisms building up a false monolithic dome (Higuera 1959, pp. 10–11, 1962, pp. 18–20, 1969) (Fig. 3).



**Fig. 1.** Higuera, F., *Monumental Fountain*, 1958 (Botia and Doval Sánchez 2019).



**Fig. 2.** Higuera, F., *Collective housing Project*, 1958 (Higuera 1969).

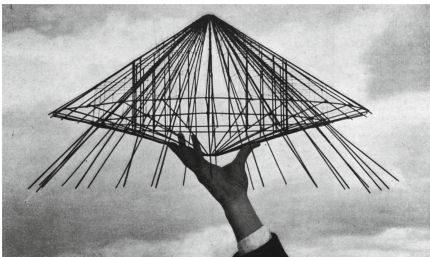


**Fig. 3.** Higuera, F., *Chapel in a Military Cemetery*, 1959 (Bergera 2016).

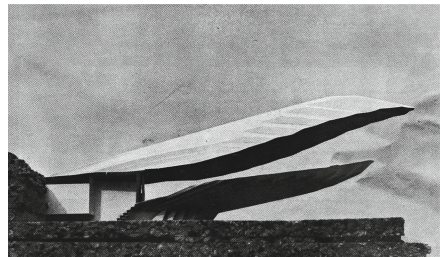
These symmetries gave way for revolution surfaces and radial structures in the projects developed with Juan Pedro Capote and José Serrano Suñer Polo for a *High mountain refuge*, 1958, with a structure made of bars (Higuera 1958, pp. 24–26, 1969), or for a *Children's theatre*, 1959, in collaboration with the engineer José Antonio Fernández Ordoñez, using folded planes (Higuera 1960, pp. 20–23, 1969).

The *High mountain refuge* (Fig. 4) is built with a structural radial skeleton formed by a unitary element of anodized aluminum that is repeated 26 times rotating around the central point, which constitutes the fireplace. Of introverted conception, similar to that of the Roman tents or the Indian tepees, to which he refers in the project memoir, it stands indifferent to the location or orientation.

In the *Children's theatre* (Fig. 5), structure and construction identify with each other, with a folded surface that absorbs all the forces, working both with compressive and tensile strength. According to the project memoir, it involves the “incorporation of hyperbolic paraboloids by Félix Candela to an organic construction in the form of a mussel, by means of a fan radial structure in the manner of folding Japanese paper lanterns”. In the scale model we experience how the edges of the planes that form the roof and the grandstand, with an oval plan, converge to an axis that acts as a hub, exerting a distributive action throughout the surface. The plane adopts a variable section, acquiring the necessary rigidity to transmit the forces and allow the projection of the cantilever.



**Fig. 4.** Higuera, F., *High mountain refuge*, 1958 (Higuera 1958).



**Fig. 5.** Higuera, F., *Children's theatre*, 1959 (Higuera 1960).

In these first scale models we can see how Higueras established a line of search from geometry, close to the one that Pablo Palazuelo defined as fertile, alive, carrier of dynamisms or energies with expansive power, capable of generating infinite forms (Higueras 1997, p. 11).

### 3 Expansive Geometries in Monte de El Pardo

The initial curiosity of Fernando Higueras marked his later work, in a continuous improvement of the same spatial intentions (Castro Arines 1978, p. 67), and giving a preeminent place to geometry and construction, in relation to history, roots and nature, as essential and inseparable elements. This spatial strategy that unites a series of concepts from geometry, leads to one of his most expressive creations, the proposal for *Ten residences for artists in Monte de El Pardo*, 1959 (Higueras 1961, pp. 6–9, 1962, pp. 22–24).

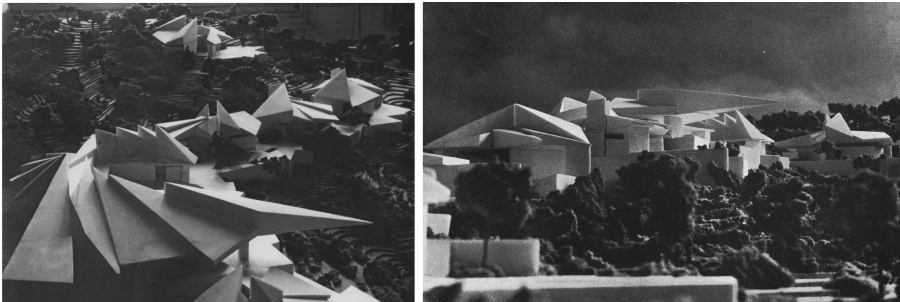


Fig. 6. Higueras, F., *Ten residences for artists in Monte de El Pardo*, 1959 (Higueras 1961).

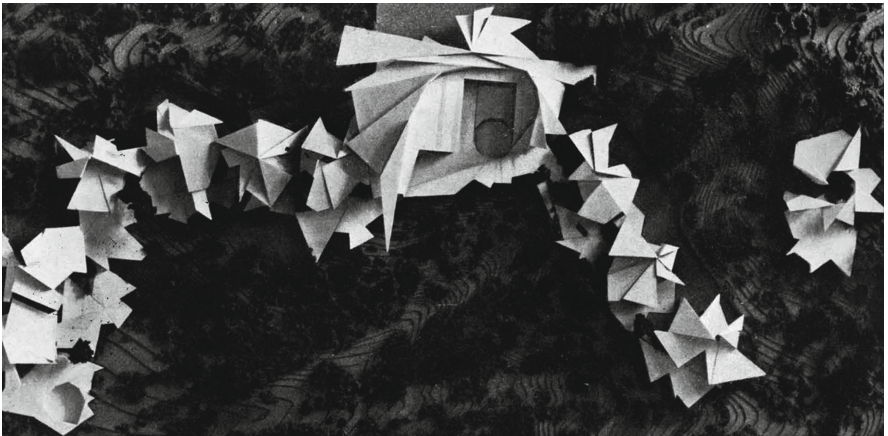
As the scale model of the project shows, it is based on the connection between architecture and environment, through the articulated arrangement of volumes on an irregular topography, such as “wood pigeons that rest between oaks” (Castro Arines, 1978, p. 67). The contour lines reproduce the slope of Monte de El Pardo, and allow studying the individual adaptation of each residence to the slope, as proof of the connection between the geometry and the territory (García Ovies 2020, p. 62) (Fig. 6). The adherence to the natural environment provides a harmonious relationship of architecture with the landscape, based on a traditional, informal and varied constructive logic (Higueras 1961, p. 7). The result, which Higueras identified in the project memoir as “analogous to the popular architecture of the *Sierra de Gredos*”, delved into the roots of traditional architecture, through an abstraction that made it timeless (Botía and Doval Sánchez 2019, p. 404). “For me, popular architecture was one of the main sources of knowledge, because in it I found naturalness, the adequacy, the order, the function, the logic, the economy, the craft, the uniformity and the variation that I cannot see so perfectly harmonized in any of the architectures of today.”

This relation with nature and vernacular is also present in the text that accompanied the prize awarded to this Project in the National Competition of 1960 (Castro Arines 1978, p. 25): “The work justifies the need for the National awards [...]. Architecture is

integrated into the earth in the same way as man does, it is explained in it, and it lives from it, to its fulfillments and demands it conforms. Flexible and open work inspired by important conquests of popular constructions, conceived as a harmonious whole, full of vigor, each piece in its individuality, different in their arrangement, as well as similar in their constructive and expressive success. Akin to the landscape, explained by the nature of the place, imagined to be blended by the demands of the landscape”.

Organicism, or the adherence to the natural environment of the whole from traditional systems, is complemented by the biomorphism or formal reference of the pieces to biological organisms. These formal relations supported, according to Alberto Humanes (Higuera 1997, p. 13), the theories of biologists as D'Arcy Thompson or Raoul Francé about the development of the technical forms from the forms of nature.

The organic aggregation of autonomous elements around a central building gives rise to a complex with an appearance of spontaneous unity, which results as an extension of each of the components (Fig. 7).

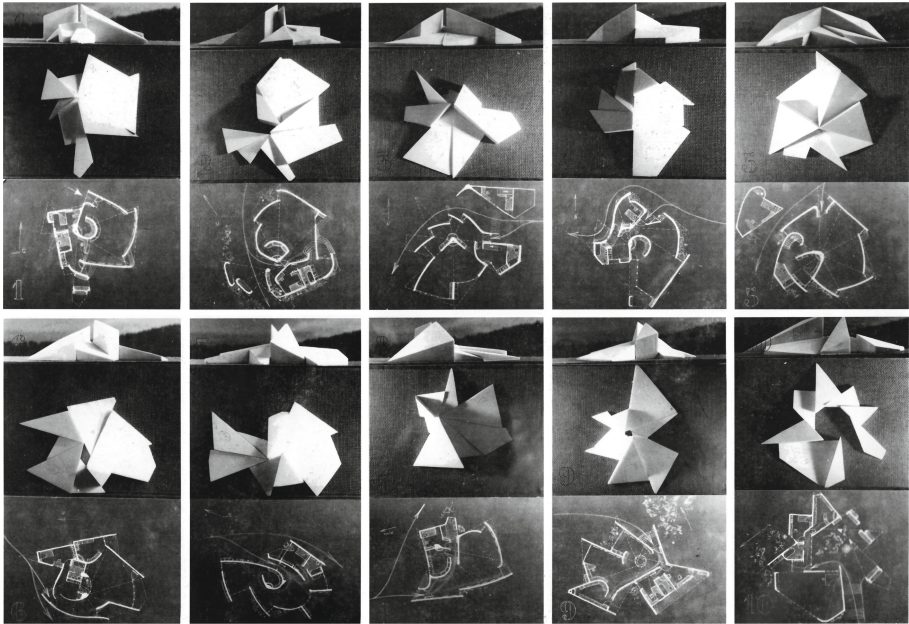


**Fig. 7.** Higuera, F., *Ten residences for artists in Monte de El Pardo*, 1959 (Higuera 1961).

These attend to the same compositional law, avoiding any seriation or repetition of modules, which increases their natural and living character. This formal freedom translates into an organizational freedom, which allows each studio-dwelling to adapt to its own functional requirements. As specified in the project memoir, “the architecture of these ten residences is conceived entirely from within, nothing has been entrusted to chance”, so the form favors the best possible development of the function in each space.

These units of studio-dwelling (Fig. 8) are formed by a spiral shaped driving force, exerted from a central point that, as in the *High mountain refuge*, takes the most static place, the fireplace. Both the enclosure and the roof respond to folding systems based on two different strategies, whose plastic autonomy brings unity.

The enclosure planes are curved and of variable thicknesses, in order to guarantee the stability of the roof and respond to the ever changing need to expand the space, in a contained way through breaks that allow the entry of grazing light, or through its projection to the outside.



**Fig. 8.** Higuera, F., *Ten residences for artists in Monte de El Pardo*, 1959 (Botia 1987).

The expansive nature of the units is made explicit in the geometry of the roof planes. The generating system starts off a 10 m' side square divided into eight different triangular fragments arranged as a pinwheel or “photographic diaphragm”, as it is called in the memoir. These triangles acquire height at the central point, giving rise to tetrahedrons in which the sloping face forms the roof, visible from the inside, and the vertical faces can be opaque or glass.

The dynamism of the form, through the prolongation of the planes and the different slopes, brings great plastic expressiveness both to the outside, because of the diversity that starts from the same pattern of centrifugal edges, and to the interior, emphasized with the entry of zenithal light and the variety of heights. The spatial depth provided by light, based on the relationship between structural order and rhythm, is one of the essential themes of architecture for Higuera. Again, he agrees with Palazuelo in the assessment of light as an inseparable element of matter (Higuera 1997, pp. 11–14): “light is matter that speaks in matter itself, matter that speaks with another denser matter in order to be able, in this way, to manifest and express together”.

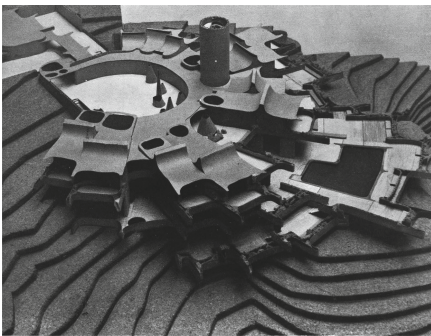
Higuera materializes his artistic expression through the language of geometry, with individuality as a determining feature of expressive capacity. The kaleidoscopic character of this set, which allows generating different organisms from the same model, is linked to a fragmented, broken geometry, to weave spaces, bend, and fold. These series of complex combinations that look for reflection and multiplicity, incorporating variations, dialogue with the harmonic order of nature. The resulting landscape, understood as a multiple body, charged with mysterious energies, variable, capable of adjusting and being governed by laws, constitutes a living and organic presence, which

Antonio López feels present in the architecture of Higuera (1997, pp. 16–17): “His projects have always conveyed to me the feeling of something alive, organic, mysterious, related to the norms of nature.”

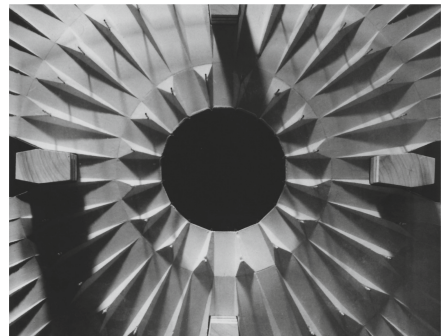
#### 4 Evolution of Expansive Approaches

The expansive spatial projection from geometric patterns of the *Ten residences for artists* was maintained in radial type structures, with which Higuera experimented through the scale model in various proposals developed during the following decade. In relation to this expansive radial structural form, with biomorphic component and dialogue with the environment, Higuera (2008) asserted: “[...] all these geometric forms are carriers of dynamisms or energies with expansive power, with power to generate other infinite forms”.

The synergies in expansive geometries generated from a center can be seen in a series of scale models corresponding to projects developed during the 1960s. The *Wutrich house in Lanzarote*, 1962, in collaboration with Pedro Massieu, is based on the projection of radial planes of different heights and longitudes regarding the slope of the terrain (Higuera 1964a, pp. 18–19). The *Exhibition and Conference Center of Madrid*, 1965, in collaboration with Antonio Miró, strengthens the regularization of radial growth with an arboreal geometry based on triangulations that delimit parallelepipeds (Higuera 1971, pp. 12–13). These proposals crystallized in the competition for a *Multipurpose Building in Montecarlo*, 1969, also in collaboration with Antonio Miró, along with José Serrano Suñer and Ricardo Urgoiti, which, as marine bones deposited on the coast, combines the two previous strategies, the relationship with the natural environment and the arboreal geometry of multiple radial symmetries (Higuera 1964b, pp 14–19).



**Fig. 9.** Higuera, F., *Wutrich house*, Lanzarote, 1962 (Higuera 1964a).



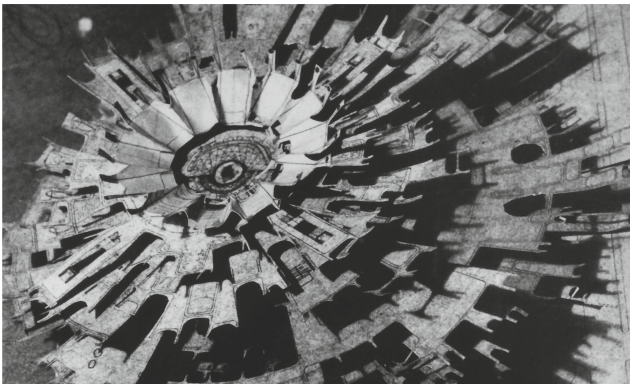
**Fig. 10.** Higuera, F., *Exhibition and Conference Center of Madrid*, 1965 (Bergera 2016).

*Wutrich house* (Fig. 9), located on the summit of a hill above the sea, combines, as depicted in the scale model, organicist references in its radial ribs and in its biomorphic skin. The informal radial structure develops around a center, an irregular access

courtyard, with open and radial forms on two levels, which avoid a clear modular repetition. This radial opening, protected from the winds, occurs with an alternation of elements, which open or close to the central space, seeking intimacy towards the hill, and open to the outside as the lens of a camera to capture the sea on the horizon and introduce it into the house. The expansion towards the landscape is achieved with an extension of the planes, both between levels and between contiguous modules, until the limit is dissolved (García Ovies 2020, p. 129).

The *Exhibition and Conference Center of Madrid* (Fig. 10) constitutes a proposal of greater geometric rigor, which delves into the radial order around a central courtyard. It is a monolithic volume elevated on a large podium, which seeks acoustic and visual isolation from the outside. The structural system was used for the first time in another introvert project, which invited to descend and enter the terrain, the proposal for the *Spanish pavilion at the New York Fair* (1963), which Higuera designed together with Antonio Miró and José Antonio Fernández Ordóñez.

For the understanding of the geometry that governs both systems, the floor plans, perspective and the scale model of the *Exhibition and Conference Center of Madrid* are fundamental, showing an aerial view of the roof. It is based on a ramified scheme to cover circular surfaces with slabs of equal dimensions, starting from a 16 sides central polygonal courtyard. The structure is developed through a combination of rectangles and isosceles triangles, analogous to that of the ambulatory of the *Cathedral of Toledo*, which Higuera took as a reference. The triangles are supported by tetrahedral beams, spatial elements that, standing on pillars located in their center of gravity, give rigidity to the structure and acquire complementary functions (Martínez Arroyo et al. 2014, p. 451–453). In this structural system, the folding is applied to a three-dimensional geometry that allows an unlimited growth of the form.



**Fig. 11.** Higuera, F., *Multipurpose Building in Montecarlo*, 1965 (Bergera 2016).

The *Multipurpose Building in Montecarlo* (Fig. 11) combines the biomorphic features and the outer envelope of *Wultrich house* with the geometric rigor of the structural skeleton of the *Exhibition and Conference Center of Madrid*. The expansive



radial shape, rooted and ramified in a set of cantilevered platforms, is generated by multiple symmetries. Its geometric composition starts from a central hexagon, from which rectangles duplicate their sides in successive rings, by means of tetrahedral beams whose length doubles from one ring to the next. These tetrahedral beams, supported by pillars aligned on their central axis, combine structure and function through the expressiveness of form. With the organic and expressive image represented by a scale model made with paper, the cantilevers are projected towards the outside multiplying the space in superimposed platforms, which nuance the vibrant light of the Mediterranean. The expansion of these planes, in search of dilation or folding, responds to the formal freedom of a living organism in harmony with the environment.

These compositional forms respond to the development of a volumetric and spatial pretension, in which geometry uses rhythmic modulations to create the “structural framework” (Castro Arines 1978, p. 67), and apply the plastic properties of its envelope to multiply and dilate the limits, in a connection with the environment tested previously at the *Ten residences for artists*.

## 5 Conclusions

The study of the scale models developed by Fernando Higuera in the mid-fifties to the end of the sixties, allows to access to a constructive and spatial logic that identifies his work. The expression of the project based on the geometric principles of order and compositional - structural clarity is carried out by establishing relationships with the function, the perception of space, and the attachment to the natural environment and the historical context, which lead to schemes of an expansive nature.

The geometric rigor of the first scale models, with open systems made with modular sequences of folded planes or linear elements, allowed Higuera to delimit specific spaces through multiple symmetries and surfaces of revolution with radial structures. These site-independent theoretical projects, which fuse geometry and construction, gave rise to a line of generation of infinite forms.

The project for *Ten residences for artists in Monte de El Pardo* involved the application of structural geometry to an organic aggregation of autonomous elements, which start from a spiral shaped driving force. Organicism, or the adherence to the environment with traditional systems and references, is complemented by a biomorphism or formal relationship with biological organisms. The geometric model allows to repeat a system of folding, which gives rise to roofs of great plastic expressiveness and are projected beyond the fluid enclosures. Spaces of great formal and organizational freedom are generated, with a living presence rooted in the place, which seek the expansion of the limits of unity to the whole and the harmonious order of nature.

The expansive spatial projection from geometric patterns of the *residences for artists* is applied to radial structures, in which the folding gives rise to three-dimensional geometries that allow for the unlimited growth of the form. The systems shown in the successive scale models until the proposal of *Multipurpose Building in Montecarlo* develop the role of geometry in structural skeletons and the organic presence with a biomorphic touch in radial forms, which are multiplied and projected with the aim of eliminating the limits.

It seems as if the projects were prolonged in each other, through a continuous discourse, which uses a volumetric and spatial ideation, ordered in several ways, more or less dilated, but driven by the same intentions. Rhythmic modulations and series of complex combinations evolved into models that promote the living and organic presence of architecture. The order and structural and compositional clarity changed into a kind of kaleidoscope that with the reflection of some compositions resolves the following ones. This process of continuous and infinite creation, characteristic of the work of Fernando Higuera, found the best way of developing its expansive geometries in the scale models.

## References

- Ábalos, I.: Fernando Higuera, infinito. *Babelia El País*, 5th July 2008
- Bergera, I. (ed.): *Cámara y modelo: fotografía de maquetas de arquitectura en España. 1925–1970* [exhibition catalog]. Ministerio de Fomento – Fundación ICO – La Fábrica, Madrid (2016)
- Botia, L. (ed.): *Fernando Higuera. Xarait*, Madrid (1987)
- Botia, L., Doval Sánchez, G. (coord.): *Fernando Higuera: desde el origen*. Ediciones Asimétricas, Madrid (2019)
- Castro Arines, J.: *Fernando Higuera, artistas españoles contemporáneos*. Servicio de Publicaciones del Ministerio de Educación y Ciencia, Madrid (1978)
- Chueca Goitia, F.: *Invariantes castizos de la arquitectura española*. Seminarios y Ediciones, Madrid (1971)
- García-Germán, J. (ed.): *Fernando Higuera. Canarias y las salinas* [exhibition catalog]. La Casita Azul – Centrocentro Cibeles – Ediciones Asimétricas, Madrid (2015)
- García Ovies, A.: *El pensamiento creativo de Fernando Higuera*. Diseño Editorial, Buenos Aires (2020)
- Giedion, S.: *Historia de la Arquitectura Moderna*, 8th edn. Gustavo Gili, Barcelona (1999)
- Higuera, F.: *Refugio en alta montaña*. *Revista Nacional De Arquitectura* **200**, 24–26 (1958)
- Higuera, F.: *Capilla Funeraria en un Cementerio Militar*. *Arquitectura* **9**, 10–11 (1959)
- Higuera, F.: *Teatro Infantil En Parque Público*. *Arquitectura* **16**, 20–23 (1960)
- Higuera, F.: *Diez residencias para artistas en el monte de El Pardo*. *Arquitectura* **28**, 6–9 (1961)
- Higuera, F.: *Hogar y Arquitectura (Monographic issue)*, 42, September–October, pp. 17–50 (1962)
- Higuera, F.: *Casa Wutrich*. *Arquitectura* **70**, 18–19 (1964a)
- Higuera, F.: *Palacio de Exposiciones y Congresos de Madrid*. *Arquitectura* **71**, 12–13 (1964b)
- Higuera, F.: *Nueva Forma (Monographic issue)* 46–47 (1969)
- Higuera, F.: *Edificio Singular En Montecarlo*. *Arquitectura* **143**, 14–19 (1970)
- Higuera, F.: *Arquitecturas* [exhibition catalog]. Fundación Cultural COAM, Madrid (1997)
- Higuera, F.: *Intexturas extracturas*. Fundación Arquitectura COAM, Madrid (2008)
- Martínez Arroyo, C., Pemjean Muñoz, R., Sanz Alarcón, J.P.: *El proyecto de Concurso de Fernando Higuera para el Pabellón Español en la Feria Internacional de Nueva York. Topografías artificiales*. In: *Proceedings Las exposiciones de arquitectura y la arquitectura de las exposiciones*, pp. 447–454. T6 Ediciones, Pamplona (2014)
- Navarro Segura, M.I.: *Desde el origen. La arquitectura de Fernando Higuera*, vol. 24, pp. 5–35. Publicación del Colegio de Arquitectos de Canarias, Basa (2001)