# Experiences in the Use of Analog Models in Micro-Architectures Design

José Luís Higón Calvet, Mónica Val Fiel

*Abstract*

*The use of analog models in microarchitecture design offers a series of benefits, from detailed exploration of small-scale elements to stimulating creativity and innovation. These enriching experiences significantly contribute to the design process and help develop more robust and effective architectural solutions. Models are tools that enhance haptic perception and play various roles in the analysis, experimentation, conceptualization, and teaching of microarchitectures. Their ability to provide a tangible and accessible representation of design makes them remarkable resources in the architectural design process.*

*Keywords: design process, analog models, microarchitecture.*

## Introduction

The logic of the design and project process demands from the designer the use of various spatial representation techniques in order to conceptualize and communicate the outcome of their work. While the tools commonly used in the project process typically start from sketches and end in representation through plans, elevations, and sections complemented by rendered images from three-dimensional models, there are cases where these resources are not sufficient to properly show and communicate the nature of the projected model, either due to the geometric complexity of the model or the nature of the material used in the design processes.
It is in these cases that the use of the model, understood as a reduced-scale physical model of the object to be represented, proves to be a highly useful tool, both during the project process and as a way to display a final result.

## The model as an instrument of analysis and communication: enhancing haptic perception

The model shares withdrawing its analytical capacity. Eduardo Carazo argues for the use of the model as a form analysis tool, "as anticipation of the project or verification of what it is going to be" [Carazo 2014].
In an analysis phase compared to digital models, physical models allow for a more direct understanding. Having a physical and tangible representation makes it possible to

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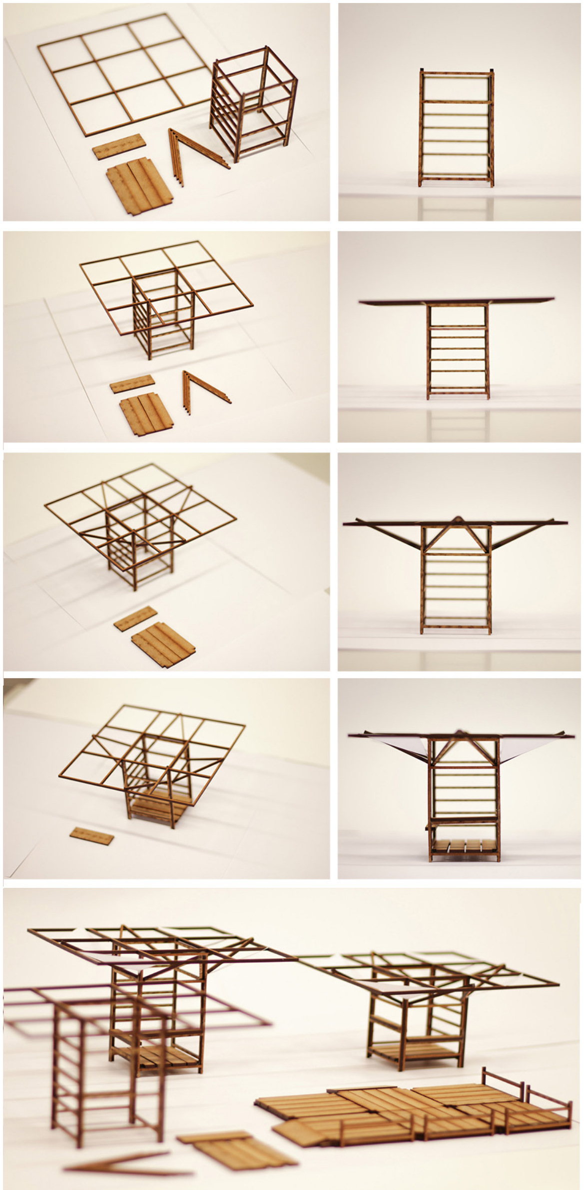
*Fig. 1. Assembly process of a tubular structure, corresponding to the ephemeral installation developed by Javier Gómez and David Minton.*



immediately evaluate forms, volume, proportions, contextualization, interior distributions, details, and other relevant aspects of the project.

Pallasmaa, in his research, advocates for the importance of all senses in the sensory understanding of space. Immersed in a technological era with clear predominance of the sense of sight, Pallasmaa emphasizes the importance of touch for understanding the world and experience, calling for a multisensory approach in the arts and architecture. "A work of architecture is not experienced as a series of isolated retinal images, but in its full and integrated material, corporeal, and spiritual essence. It provides pleasing forms and surfaces shaped by the touch of the eye and other senses, but it also incorporates and integrates physical and mental structures that grant our existential experience enhanced coherence and transcendence" [Pallasmaa 2022, p. 13].

Pallasmaa analyzes the essential role of the hand in the evolution of skills, intelligence, and conceptual abilities [Pallasmaa 2012]. Models consolidate and refine our ideas to the extent of rendering them constructible. The project defines its existence through an object shaped by hands. "Through our hands, we engage with what is projected. Working with our hands leads us to internalize or externalize something that will eventually become part of the project" [Dorado 2013, p. 197] .

In the context of architectural design and models, haptic perception plays an important role in the understanding and evaluation of spaces and structures. Models, as tangible objects, enhance haptic perception by allowing a complete sensory experience of the project. By physically interacting with a model, either through direct manipulation or by contacting surfaces and materials, one obtains comprehensive information about the proportions, textures, and spatial configuration of the project as a whole. This aids designers, architects, and other stakeholders in understanding, communicating, and making decisions in the design process.

The model as a communication tool not only allows visualizing the final design but also facilitates understanding of the construction processes. Through the analysis of the model, those involved in the project can learn about construction processes, including the installation of structural systems and the integration of facilities. Manipulating and studying the model helps identify potential challenges, clarify construction details, and visualize construction sequences, providing a deeper and more practical understanding of how the actual construction will take place. In this way, the model becomes a perfect tool to get as close as possible to the reality of construction before starting the actual assembly (fig. 1).

## The analog model versus the digital model

The creation of physical models or prototypes to scale has been and continues to be a common resource in the design and development processes of products, despite the enormous possibilities offered by computer-based media to generate and visualize virtual models. When infographics were able to offer photorealistic results of high quality, the relevance of these result models that usually starred in the presentation of any project was questioned. However, professional activity, perhaps guided by the force of habit, demonstrated the effectiveness of using this resource during the project process.
In the field of architecture and design, the so-called 'working model' allows for a preliminary approach to the spatial and formal reality that is being developed, offering unexpected perspectives and revealing possibilities not initially foreseen once the design process has begun and the initial proposals have been graphically defined. It materializes a recreation of the idea being defined, which can be manipulated and transformed at will, providing continuity to the creation process in coordinated alternation with graphic resources. Even in its construction process, the model offers from the outset a series of sensory and material experiences that digital representation is unable to provide.
Architects like Eisenman integrate the use of models as a process of interaction with digital media. Eisenman justifies the dialogue between physical and digital models as a back-and-forth journey between computer models and physical models. He argues that models serve to see how space will be: "With the computer, you can only go around nothing... with three-dimensional models, I can see what is really happening [Mills 2011, p. 144]. "When Eisenman describes his design process, he determines that he always establishes a dialogue between two different models of the project under development. Models are a constant in the process, but always after a conceptualization phase, which takes place on the computer. 'I know what I am trying to achieve theoretically,' explains Eisenman, 'and the models tell me whether I am achieving it or not'" [Val Fiel 2016, p. 143].

## The model as a means of experimentation

New materials and technological changes have expanded the ability of the model to articulate ideas [Moon 2005]. These advances have transformed the way models are constructed and offer designers a wider range of tools and techniques to represent and communicate their ideas. In this context, the model is presented as a project in itself. The model as a 'project' to be solved involves approaching its creation with a methodological and creative focus, similar to the architectural design process. This includes clearly defining the purpose, seeking and selecting suitable materials, determining the scale, and planning the construction process, among others (fig. 2).
By directly manipulating a physical model, designers can experiment with different forms, structures, and arrangements in an intuitive manner. This can lead to the generation of new ideas and solutions that may not have been considered otherwise.
In the early stages of the project, the model is not limited to a real representation of the object to be built, but can be an analytical element where information can be extracted to shape subsequent phases of the project, adding value to the creative process.
Furthermore, working with the model demands a process of synthesis and abstraction that contributes to clarifying

*Fig. 2. Model of ephemeral installation made with foam board. Author: Saul Rojas Bombal.*

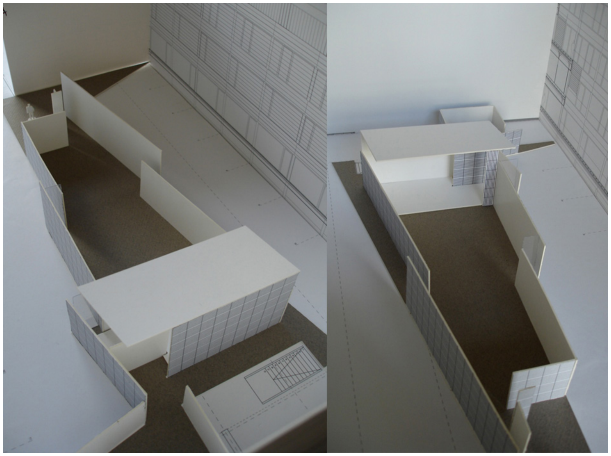


Fig. 3. Test model for a scenic background project. Author: Ignacio Gutiérrez Soto.

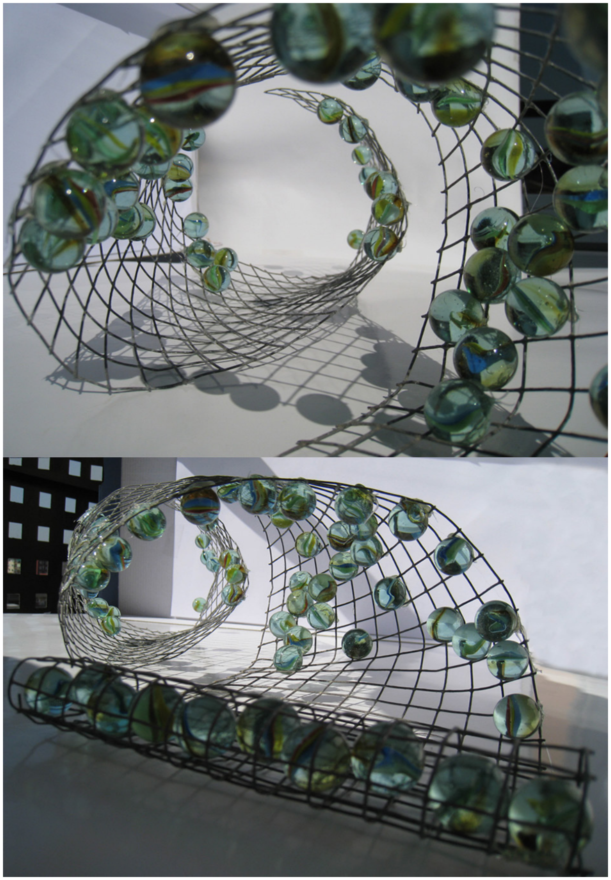
project ideas and how they materialize. A flow is established between the project objectives and their confirmation in a small-scale model, which can confirm its validation or open up other avenues of development.
Contrary to the model as a reproduction of a real project, it is important to highlight the consideration of physical models as part of the design process in any phase of project definition.
At this stage, models are used as tools for exploring ideas, experimenting with forms and volumes, focusing on capturing the essence of the design without reaching the definition of details "they pose problems and formulate hypotheses, understanding and teaching to understand, avoiding that works escape us" [Álvarez 2011, p. 13].
In the project development, the use of physical models enables formal exploration, along with the review and validation of certain ideas. Alternatives are explored on the material itself, with versatility and immediacy being the most significant advantages of this medium in the design process (fig. 3). The model is used as a tool for idea generation, experimenting with a purely formal definition that subsequently evolves and acquires content regarding the development of an idea that later incorporates functional and constructive requirements.
In an initial phase, the model offers the opportunity to test different ideas, concepts, and solutions, and explore the feasibility of innovative or unconventional ideas. The working model allows for the investigation of multiple design options and the quick evaluation of their spatial configuration as a whole, without the need for extensive skills and time management in software usage.
At intermediate or detailed scales, it allows for experimentation with a variety of materials and textures to determine which ones may work best for the project. It enables testing different cladding materials, interior and exterior finishes, in order to find the desired combinations.
Iteration and successive adaptation are among the most notable aspects. Building models enables designers to iterate and continuously refine the design throughout the process. Rapid changes can be made and different options can be compared to enhance the functionality, aesthetics, and performance of the project. A flow is generated between exploration in the process, materialization, and ultimately the realization of the project idea.
In this experimental context, the use of folding techniques for creating three-dimensional forms is remarkable. The fold has been a constant in all artistic periods, the fold as a

resource for ideation and conceptualization. "Multiplicity is not only what has many parts, but what is folded in many ways " [Deluze 1989, p. 11]. "The ideal genetic element of variable curvature, or of the fold, is inflection. Inflection is the true atom, the elastic point" [Deleuze 1989, p. 25]. Not only folding but also bending flat surfaces to generate active surface structures, with self-supporting capacity [Shen, Nagai 2017]. Developable surfaces, generating volume, three-dimensional forms from a flat shape (development) through bending and/or folding (fig. 4).
Experimentation with form allows for infinite possibilities of a plastic nature, but the necessary constructive rationalization to make the object viable or constructible suggests the use of geometric patterns, which do not necessarily have to limit the designer's creativity. Research in this regard has evolved in recent times, so that we have multiple examples and even studies that seek to systematize folding techniques. Through straight folding, it is possible to obtain polyhedral surfaces. Through curved folding or directly curving the flat development, it is possible to obtain surfaces of simple curvature, conical or cylindrical, but also others of greater visual complexity and structural capacity due to double curvature [Jackson 2022].

## Specificity in the context of micro-architectures

Micro-architectures, as well as ephemeral architectures, due to their nature of maximum expressiveness with minimal constructive elements or limited material resources, are susceptible to experimentation and testing during the ideation phase through the development of analog models. Micro-architectures projects are characterized by the creation of small-scale structures, shelters, urban furniture elements, or ephemeral installations among others (fig. 5). Due to this condition, because of their specific nature and reduced size, these projects allow designers to innovate both in terms of functionality and exclusively formal approaches. Some notable issues in the use of models in the context of micro-architectures are their integration into the field of action, their relationship with human scale, and the choice of materials.
At a primary level, physical models allow analyzing the influence of the environment. They enable the designer to evaluate the influence of the urban structure on the micro-architecture (views, sunlight, etc.) and more immediately identify the potentialities of the context.

*Fig. 4. Working model made with wire mesh and marbles. Author: Ana Blaya Rodríguez.*



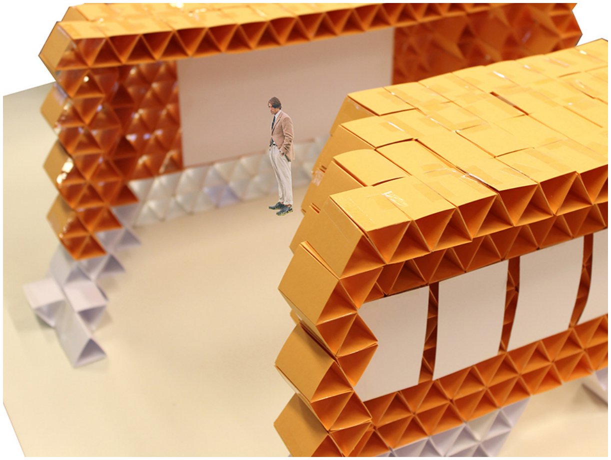
Compared to the definition of digital models, the model presents itself as a highly flexible tool, in which elements can be manipulated and modified within the environment, directly observing the changes they produce in the space in which they are inserted and in the scope of action. The visualization of the result and spatiality is direct and is not reduced to the discretization of viewpoints or the focus to which digital rendering representations are limited.
At a secondary level, physical models allow designers to assess the relationship between space and human scale. This issue is particularly important in the design of small spaces where physical models assist in deciding on ergonomic and comfort-related matters. Designers can simulate human interaction with the built environment and make adjustments as necessary to optimize the user experience.
Finally, research and testing with multiple materials and textures are notable because the choice of material can have a particularly decisive impact on the form and function of the project (fig. 6).

*Fig. 5. Model made of wood with textile fastening. Ephemeral installation project developed by Barbara Maestre Fenoll, Jon Maiztegui Etxaniz, and Luis Marques Marti.*

## Discussion

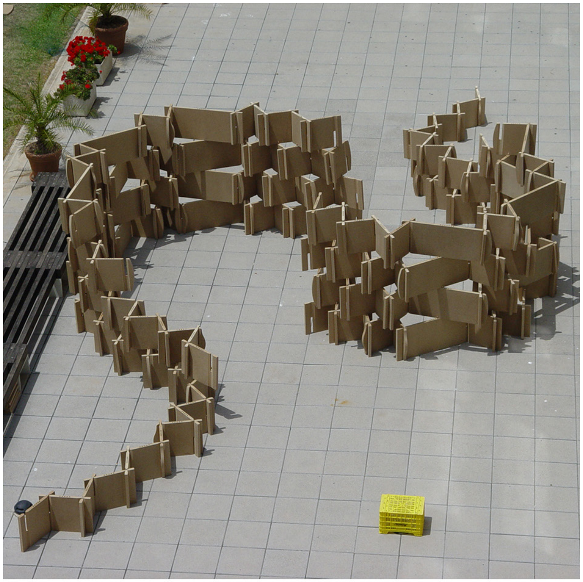
In the educational context, the model compels the designer to adopt an active attitude in the learning process [Álvarez 2011], fostering creativity and teamwork. Additionally, working with models develops spatial and representational skills, including the ability to manipulate three-dimensional objects. From visualizing abstract concepts to simulating construction processes, it is a valuable tool for enriching the learning experience and promoting longer-lasting learning.
Regarding the materiality of analog models, although the tendency in their selection often aims to mimic the represented nature, it is advisable to reflect on whether such materials reaffirm the initial project intentions or not.

*Fig. 6. Model made with triangular cardboard pieces. Authors: Rafa Megías Vizcaíno and Elisa Sanz Peris.*



Manipulating materials and observing the results in the model provide insight into the inherent characteristics and qualities of the materials, which can be incorporated into subsequent projects.
The development of physical models as a resource for analysis and experimentation in project definition is an enormously valuable tool that facilitates, as we have generally observed in our experience, the process of ideation and formalization of different proposals.
Scale models are constructed and integrated into the project definition process during ideation as working models, with varying degrees of abstraction from the idea being materialized, and coordinated with the usual graphic resources, from freehand sketches to 3D modeling on the computer, as the project takes shape.
Regarding infographics, despite their significant development in recent times and ease of use in producing virtual models, it is important to understand them not so much as an opposing procedure, but as complementary to the use of physical models on a reduced scale. While virtual models indeed allow for more agile management of project modifications, physical models provide information whose quantity and quality enable untrained observers to understand the project without other prior information. It is also worth noting that, for representation purposes, physical models allow for obtaining high-quality photographs from them, whose ultimate purpose is the same as that pursued with rendered images, thus achieving a result analogous to that obtained from a virtual model.
The development of ephemeral installations as examples of micro-architectures provides a valuable opportunity where the project can be materialized with a full-scale model. This culminating stage of the process allows for validating and confirming the materialization of the project idea. Experimenting with a process similar to that of constructing the real project, from material selection and manipulation to resolving construction details, including acquiring cross-cutting competencies such as team coordination and practical skills, allows for confirming the successes and errors that may have occurred during the project process. Additionally, creating a 1:1 scale model serves as a tool that confirms learning about scales. The designer can directly compare the full-scale model with their original design and evaluate the relationship between physical dimensions and previous scale representations.

*Fig. 7. Top: General image of the proposed route. Bottom: Partial image of the temporary installation, placed in relation to human scale. Ephemeral installation projected by Mercedes Cepeda Zaragoza.*



## Conclusion

In certain instances, and due to the complexity of the geometry to be represented, obtaining a faithful three-dimensional digital model of the concept being projected proves difficult to address. This is both due to the inherent limitations of the software used and the significant amount of time required for its development. In other cases, the chosen materiality for the project's development may be challenging to represent and render, as it involves materials whose texture and configuration would require substantial effort to generate the desired visualizations. It is in these cases that the true potential of the reduced-scale physical model is revealed. Such models allow for simultaneous reflection on the logic of the chosen material and provide a good approximation to the final result. In some instances, when budgetary and time constraints allow, these models may be used as a preliminary step prior to the realization of full-scale proposals, thus completing the entire cycle from ideation to real-scale formalization of the project (fig. 8).

*Fig. 8. Full-scale ephemeral installation developed with recycled plastic baskets. Author: Ana Mas Gil.*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