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Educational breakdowns. Learning proposals with games, models, prototypes, mock-ups, and detachable architectures

Despieces didácticos. Propuestas de aprendizaje con juegos, modelos, prototipos, maquetas y arquitecturas desmontables

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ABSTRACT An effective way to learn architecture is through educational breakdowns, dissecting architecture with a thorough understanding of its components. Developing learning approaches with construction games, prototypes, scale models, and temporary or detachable architectures opens up an interesting field for experimentation in teaching architecture, from the beginning to the advanced stages. The use of approaches based on educational breakdowns will allow for the design of teaching strategies at various scales, ranging from the reduced scale of a model to the realistic scale of detachable architecture. For the architect, the analog model becomes the designer's toy, with which they test the variables of a future implementation. Detachable architectures are built like a game, with parts that are assembled. Learning through breakdowns, experimenting with models and architectures, effectively blends the serious aspects of construction with the playful nature of play.

RESUMEN Una efectiva manera de aprender arquitectura es a través del despiece didáctico, de diseccionar la arquitectura conociendo bien sus componentes. El desarrollar propuestas de aprendizaje con juegos de construcción, modelos, prototipos, maquetas a escala y arquitecturas efímeras o desmontables, abre un interesante campo para la experimentación en la enseñanza de la arquitectura, desde los inicios a etapas avanzadas. La utilización de propuestas en torno al despiece didáctico permitirá diseñar estrategias de enseñanza en diversas escalas, que irán desde la reducida de la maqueta, a la real de la arquitectura desmontable. Para el arquitecto la maqueta analógica se convierte en el juguete del proyectista, con ella prueba las variables de una futura materialización. Las arquitecturas desmontables se construyen como un juego, con piezas que se montan y ensamblan. En el aprendizaje desde el despiece, al trabajar con maquetas y arquitecturas, se entremezclan eficazmente lo serio de la construcción con lo lúdico del juego.

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1. Introduction

Removable architecture, which is designed to be assembled and disassembled, as a variable of prefabrication, is generally preceded by mock-ups, models, or prototypes. Experimentation and testing during the design process are necessary constants to formalize the project in the field of design and construction, with pieces assembled to build something from architecture (or through it). These conditions make this type of architecture an effective teaching resource through testing with mock-ups, models, or prototypes, which allow us to play with all the possible variables of assembly, fit, and component shape, and to anticipate a definitive architectural realization. In training activities, we could structure a series of teaching proposals on demountable and dismantled architectures, divided into three sections: construction toys/games, demountable models, and the analysis/construction of ephemeral or demountable architectures, through notable cases.

Mazzanti (2024) puts forward a utopian and stimulating proposal for the learning of architecture students, through the conception of his school as a demountable architecture (Figure 1). While studying in the building, students participate in a process of constant assembly and disassembly of the school, according to the needs of the educational activities proposed in the course:

What would happen if we designed a building in which students and teachers could arrange and organize spaces according to the topics or research they are conducting? (...) A building made of cranes, rails, movable walls, among other devices, left at random, so that the inhabitants can arrange them as they imagine in an act of cooperation and learn by doing architecture on a 1:1 scale; the space ceases to be a place of order and becomes a place of imagination and creation by the active educational community... (Mazzanti, 2024, p. 25).

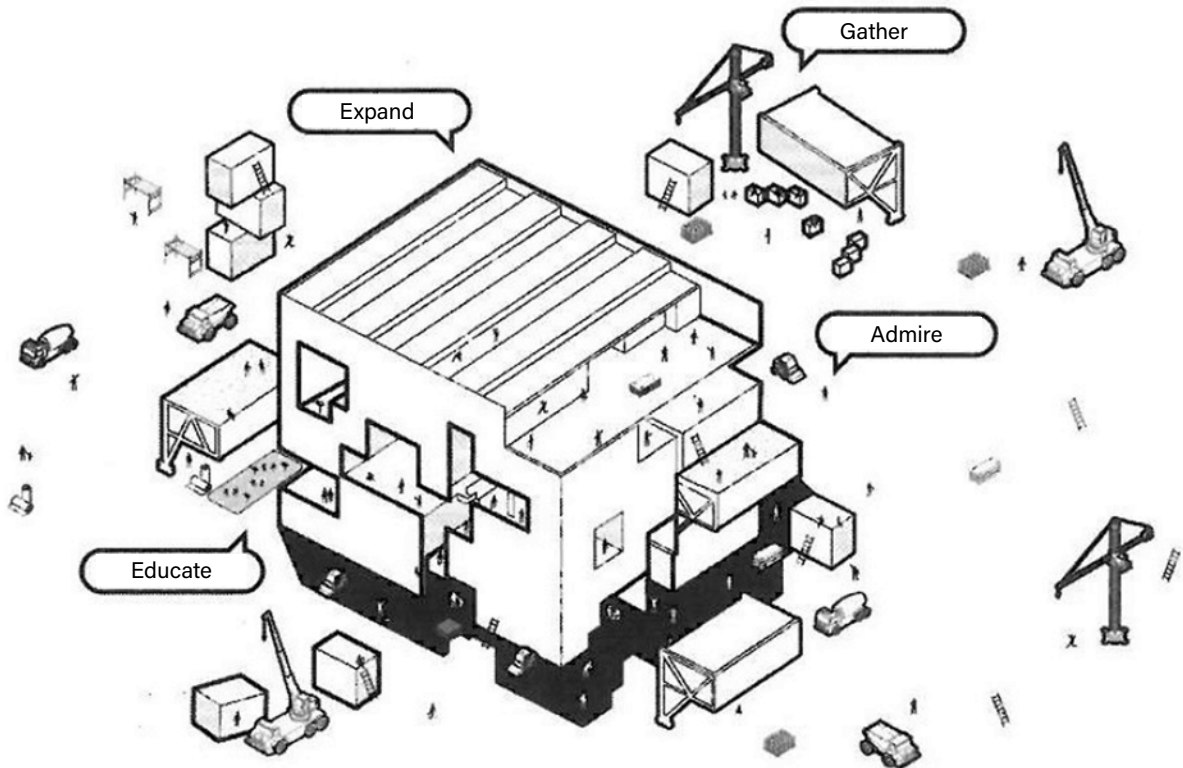


Figure 1: Mazzanti's educational proposal, the school as a great experimental game. Mazzanti (2024)

Mazzanti's school, predictably indebted to Cedric Price's flexible, modular, and changing projects in Fun Palace (1960) and Potteries Thinkbelt (1964), encourages us to consider various ways of teaching architecture in a similarly active way. This proposal would probably be unfeasible today, but we can approach this utopian idea with imagination and creativity, using other educational approaches such as construction games, demountable models, and the analysis and construction of demountable structures. With these three resources, even if we cannot use the school itself on a 1:1 scale, we can work, play, and think about architectural project strategies and experiment directly with architecture.

In an education increasingly influenced by digital technology, it is necessary to use our hands and bodies to assemble and disassemble, with resources ranging from models at different scales to promoting the handling of real materials, using actions such as assembling, locking, fitting, joining, splicing, articulating, and tongue-and-groove, among others.

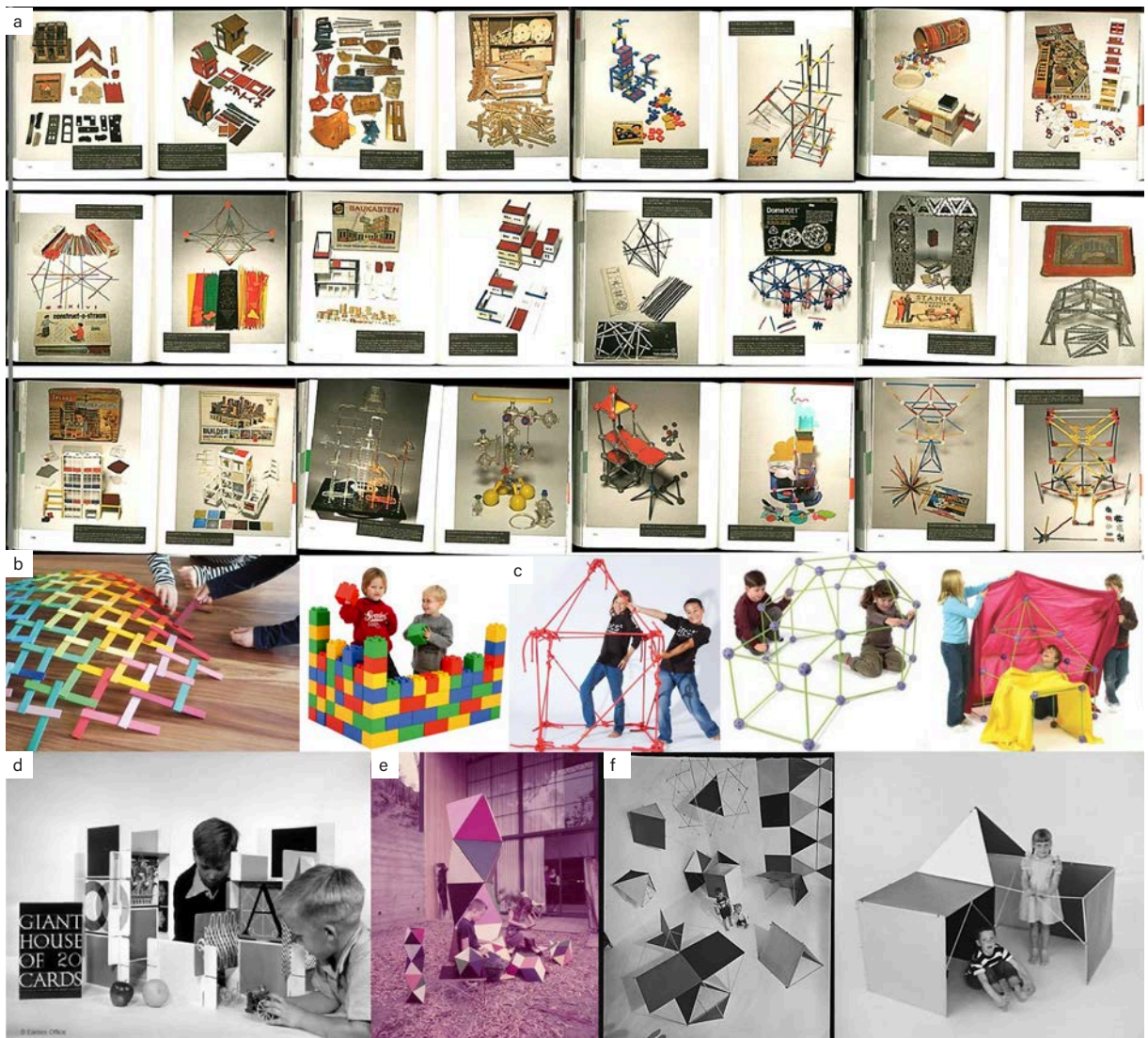


Figure 2: a) Selection of some construction games; b) Construction games, assembled pieces by Leonardo Sticks (2024); c) XXL blocks, d) Stocs strings (2016); e) Crazyforts rods with connectors; f) Eames construction toys, House of Cards, and The Toy. a) Bordes (2012); b) Veobio (2024); c) Hermex (2026); d) Stocs (2016); e) Crazy Forts (s.f.); f) Herman Miller (2026). Eames Office (2021)

These haptic practices will provide students with learning directly related to the construction trade, as Pallasmaa (2012) states:

the most important skill of the architect is to convert the multidimensional essence of the design work into bodily and lived sensations and images; ultimately, the entire personality and body of the designer becomes the site of architectural work, which is lived rather than understood (p. 12).

Teaching from a new craftsmanship, in which “incorporating the possibilities of digital technology from a bodily intelligence” (de la Cova Morillo, 2016, p. 15).

2. Methods

Various teaching experiences have been developed around the breakdowns in different courses, from beginner to advanced. In the multifaceted, expository article, we do not address in detail variables such as the study population, statistical methods, or laboratory procedures. Given the length of the article, we have chosen to show together various teaching activities whose common link is the breakdown. We have worked on several modalities that fall within the compulsory practical work of subjects or teaching seminars, as well as on voluntary activities or on others outside the scope of studies, such as events to promote the discipline of architecture, open to other educational fields or to a general audience. Obviously, more detailed studies could be carried out on each of the cases or teaching types presented, focusing on breakdowns, observation, data collection, and analysis of the indicated variables. This approach could be the subject of future work, derived from this initial overview.

The educational activities involved in dismantling this panoramic work are grouped into the three fields indicated. Construction games are a complementary activity in architecture studies. These architectural models are integrated into the compulsory practical work of graphic, project, or technical subjects, as well as into external events to promote architecture studies. The analysis/construction of demountable architectures are developed through specific seminars, advanced courses, and voluntary activities. We deal with each of these modalities in a separate section, describing their values based on a documentary review of notable precedents. These sections include images composed of diverse cases, arranged in a mosaic. We have chosen to offer a single, panoramic summary image composed of several selected examples, rather than focusing on detail or a single image. This option is more in line with the article's purpose, even though we are aware of a possible detriment to quality or clarity in perception, which is why all the images included are referenced. The reference provides access to the sources from which it was extracted, in case there is interest in expanding the information on any case.

3. Analysis

3.1. Toys/construction games

In Mazzenti's proposal, the school would be like a large, life-size toy with which the student maintains a physical and creative relationship. This is an educational initiative that takes us back to childhood and construction games. Architectural construction games and their numerous variables were the subject of study by Bordes (2007, 2012) in a series of carefully crafted and attractive publications. This author explores the links between games and real prefabricated architecture, which share construction mechanisms, differentiated by scale:

Most construction toys share a foundation with architectural prefabrication, as the modularity of their pieces enables great construction versatility. However, it is not enough to start with a small module for architecture to be considered prefabricated. We consider this construction technique to be present when the architect uses complex units manufactured in auxiliary workshops, drastically reducing the time required to erect the building to a few hours (Bordes, 2012, p. 196).

As Klickzkowski (2002) points out: “Prefabricated construction is no longer understood solely as a construction method that is used because of the considerable savings in time and money on the site. It is also a typological alternative that solves the most complex situations and programs” (p. 6). Demountable architecture, ephemeral architecture, and prefabrication share a common interest in seeking other ways of approaching construction, with their own distinctive values (Blasco Rodríguez, 2011):

Values that have always characterized ephemeral architecture, such as lightness, recycling, standardization, mobility, storage, sustainability, economy, and transience, have enabled rapid responses to emerging realities: social, political, technological, architectural, philosophical, etc. The ease and speed with which ideas can be transformed into reality make ephemeral architecture an agile platform for thought, experimentation, and development. This has made it a field in which utopian or artistic projects, as well as charitable and humanitarian ones, have found an appropriate avenue for their development (p. 2).

These qualities, well described by Klickzkowski (2002) and Blasco Rodríguez (2011), can be easily approached using the various types of construction sets, clearly classified in Bordes' extensive publications (2007, 2012). As an accessible resource, we could highlight games such as “The Toy” or “House of Cards” by the Eames, which allow, with simple construction mechanisms, the building of numerous shapes on different scales, from the small scale of the model with “House of Cards” to the real scale of a children's shelter or cabin in “The Toy” (Figure 2).



Figure 3: Didactic breakdowns in demountable models. a) Le Corbusier, series of models for the Marseille Housing Unit and photomontage explaining the basic principle of the building, Marseille Housing Unit; b) Model with removable cover for the Museum of Unlimited Growth, 1939; c) Model with removable cover for Ronchamp, 1950-1955; d) Guggenheim Museum, Frank Lloyd Wright, 1956-1959; e) Louis Kahn, A. N. Richards Medical Research Laboratory, University of Pennsylvania; f) Mikveh Israel Synagogue, 1962-72; g) Louis Kahn, 1949, Headquarters for the United Nations Educational, Scientific, and Cultural Organization; h) Sequence of the assembly of the model of the Dhaka Assembly building, 1961, taken from the documentary film. a) Monteys (2005, p. 149); b) Archetypal Materiality (n.d.); c) MOMA (2026); d) Brooks Pfeifer (1994, p. 283); e) Giurgiola (1974, p. 165); f) Tabletmag (2009); g) Muñiz, (2025); h) Kahn (2004)

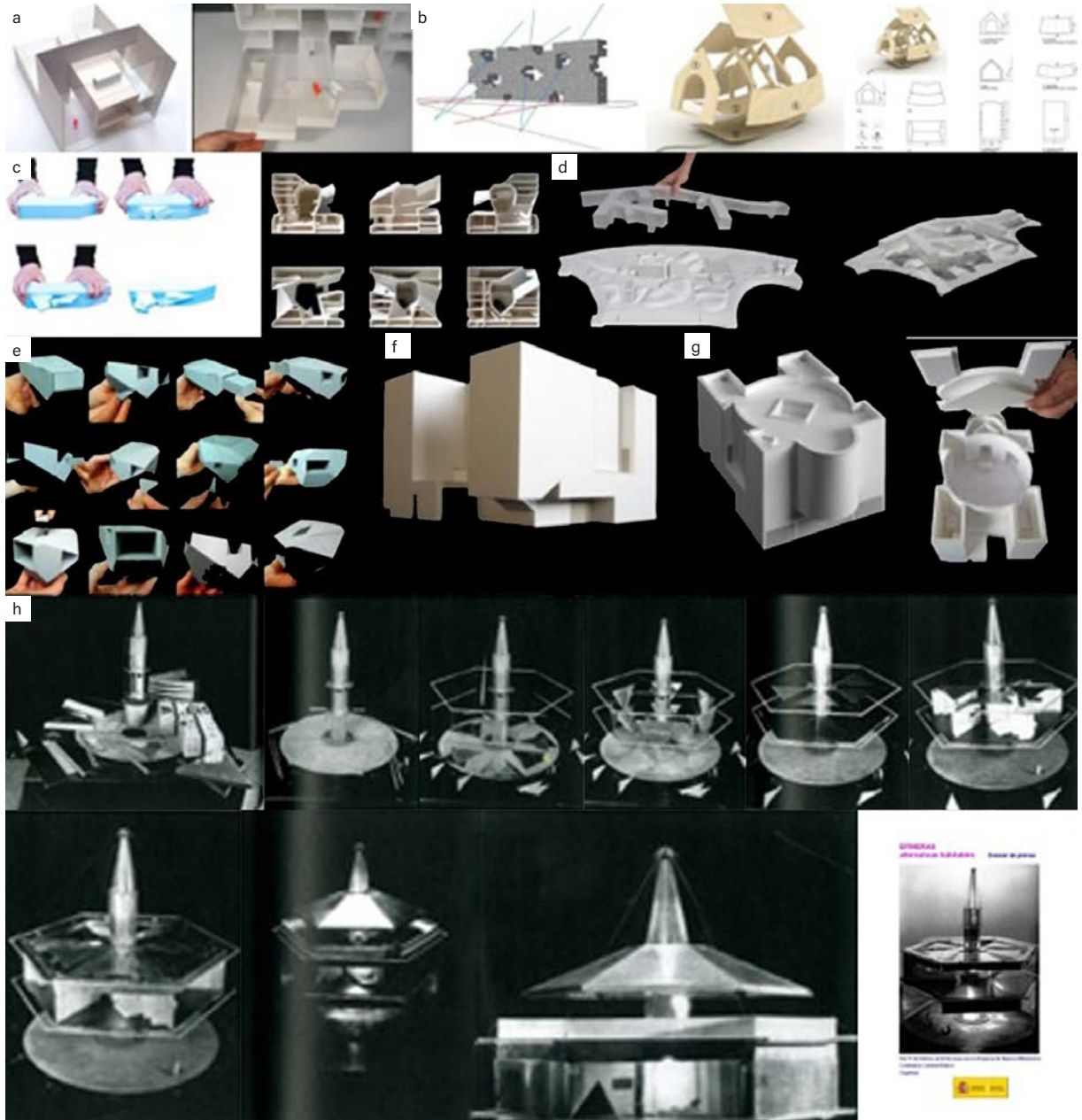


Figure 4: Didactic breakdowns in collapsible models. a) MVRDV: Donau City Slab, Vienna, 2006; b) Bagle House, 2012; c) Pushed Salab, Paris, 2010; d) Steven Holl: Tianjin Ecocity Ecology and Planning Museums, Tianjin, China, 2012; e) Vanke Center Shenzhen, China, 2010; f) Rem Koolhaas: Casa da Música, Porto, 2001; g) Alvaro Siza: St-Jackes-de-la-Lande Church, Rennes, France, 2009; h) Sequence of the assembly of the model of the Dymaxion House, final version, 1929. Work chosen for the cover of *Efímeras, alternativas habitables*. Press dossier. May 17–19. a) MVRDV (2026); b) MVRDV (2026); c) MVRDV (2026); d) Steven Holl (s.f.); e) Designboom (2026); f) Orna Office (s.f.); g) Siza (2013). h) Snyder (1980, pp. 68-69). Blasco Rodríguez (2011)

Both games allow for easy actions such as assembly and disassembly to generate different architectures or architectural forms, as proposed by their designers in the instructions for each game.

On models and toys, Clemens Holzmeister writes: "A model is impressive if it is well made; however, it has always been and will continue to be just another item in a child's toy box" (Sainz, 1990, p. 25). Rather than interpreting this statement as a supposed shortcoming of the model in relation to the toy, we prefer to see it in a positive light and recognize the game's capacity to also be an excellent complementary field of experimentation in the teaching or practice of architecture and construction.

Various authors have studied the relationship between models, games, and toys. For Carazo Lefort (2011), architectural models have limitations and advantages. Among the latter is their playful nature, which invites the observer to touch them, play with them, and manipulate them, perhaps reminiscent of children's toys:

Models have always had certain limitations. Some are obvious, such as their costly execution and demanding requirements for quality materials. At the same time, their materialization involves a type of "construction process" that is also costly and highly specialized, which in a way emulates and anticipates the process that will be used to produce the building it is intended to represent. Or the difficulty of preserving them—the reason for their scarcity—given their size, fragility, and, above all, their inherent playfulness, which invites people to touch them (pp. 35-36).

Ramonedá (1997) detects an obvious connection between models and toys: "the model. Model of what? The model has something of a formal quintessence, of intermediation between the world of ideas and the world of reality. The model is the artist's toy" (p. 2). Jean-Jacques Wunenburger (1997) also highlights its capacity as a suggestive sensual object that invites play:

The reduced model seduces the eye and excites feelings of pleasure because, belonging as it does to a part, a partial element of a form contains a totality, that is, it acts as a substitute. In the model, the total, immeasurable being is reduced to the appearance of a fragment which, when exposed to the eye, makes one believe that one has mastery and enjoyment of the whole. (...) Hence, perhaps, the dreamlike power of the toy, which reduces the immensity of the world to the scale of the player and grants them an unprecedented vision (p. 22).

All these authors agree on the intrinsic playful nature of the model-building process, which involves prior planning to select materials, cuts, and assemblies, components that also play a role in construction games (Deriu, 2016).

These observations connect us to the next section: the collapsible model, which has a different design, is constructed from pieces that can be assembled and disassembled.

3.2. Detachable models

Architectural models can be approached using various strategies, with variables such as scale, material, degree of detail, and formal synthesis, among other factors. Being dismountable requires specific planning. Models and prototypes for prefabricated architecture will also serve as a "typological alternative" that will allow complex situations and programs to be resolved. In many cases, these models will also be dismountable, providing an alternative to many other approaches to their construction. Dismantling or disassembling dismountable models can be done in many ways, depending on the intended purpose. A dismountable model will not always result in dismountable architecture.

There are numerous types of demountable models and ways of dismantling them, and we can find numerous references that can serve as models. If we refer specifically to demountable models, dismantling and reassembly have become part of the iconography of architecture. It is common for a model to be dismantled to explain or demonstrate the project it represents. Among the most notable cases, we could highlight Le Corbusier's educational dismantling of his models, which were photographed to explain his architectural approaches. As Deriu (2016) points out, regarding Le Corbusier, his dismantlable models, and how they were photographed:

Photography of the model was not only used to foreshadow the form of things to come, but also to represent a design process. Hence, for example, Lucien Hervé photographed the modular system of the *Unité d'habitation* for Marseille in a careful composition that transformed the dismantled model into a familiar construction toy (p. 35).

In this project, the structural configuration is advanced to be used in its construction, combining a construction set with a model made up of assembled pieces. When designing prototypes, projects that could be repeated and placed in different situations, Le Corbusier would use the model to display them, photographing assembly and disassembly sequences (Montaner, 2002), a resource intrinsically linked to his conception of architecture:

As the machine model, essential in the industrial world, was adopted as the predominant reference, the prototype was selected as the project mechanism. During the modern movement, the type was replaced by the prototype, promoting an aesthetic of repetition. Much of the residential work of Le Corbusier and Mies van der Rohe consists of architectural syntheses based on basic, almost

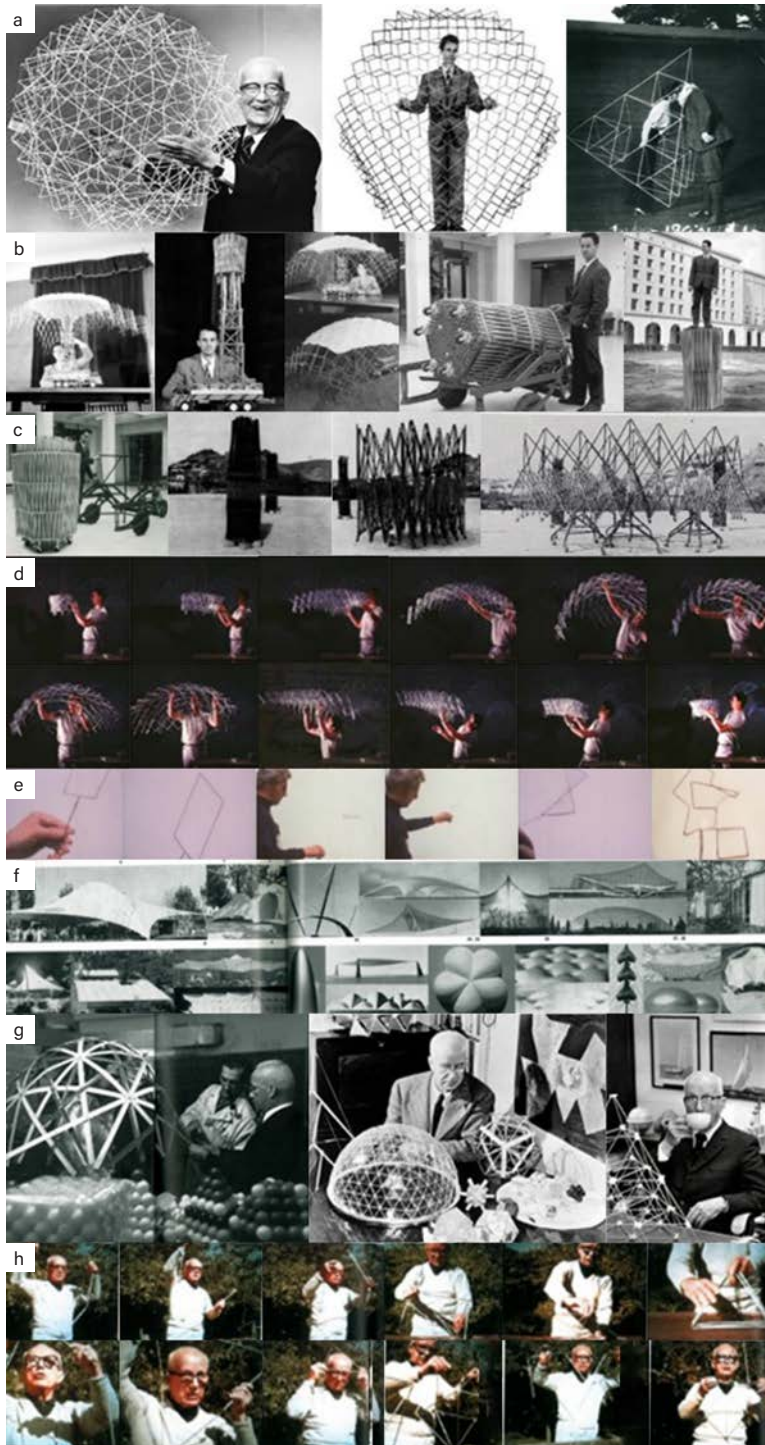


Figure 5: Architects, inventors, and demountable architectures in a playful mood. a) Buckminster Fuller; b) Emilio Pérez Piñero; c) Alexander Graham Bell with his wife, Mabel Gardiner Hubbard; d) Emilio Pérez Piñero. Model of the pavilion for the exhibition commemorating 25 Years of Peace. Transportable foldable structure made in Madrid in 1964. Foldable Lowered Dome, 1962; e) Stills from "Las estructuras vivas de Pérez Piñero" (The Living Structures of Pérez Piñero), experimental model of a reticular structure for a traveling theater, 1966; f) Frei Otto. Models, mock-ups, and prototypes; g) Stills from "Soap Films and Tents, Experiments, Models, Projects, and Executed Buildings", sequence with Frei Otto experimenting with soap bubble membranes; h) Buckminster Fuller at the Chicago Institute of Design, 1984. Sequences of the triangle to the icosahedron taken from the film "The world of Buckminster Fuller" by Snyder, 1980). a) Pereira (2018); b) La opinión de Murcia. (2013); c) Picryl (2026); d) Arquiscopio (2026); e) Nordenso (2008, p. 66); f) Pereira (2018); g) Roland (1973, pp.156-165); h) Hennicke (1981); i) Snyder (1980, p. 20, 21, 116)

archetypal structures, which in the case of Le Corbusier are explicitly used as prototypes. We refer to the spatial and constructive structures of *the sandwich* or pavilion and the *megaron* or courtyard (p. 88).

We can find numerous examples of models taken apart and photographed in modernity, images already associated with the graphic imagery of the modern movement, widely disseminated and recognizable. As shown in Figure 3, architects such as Le Corbusier, Wright, and Kahn would didactically display their models taken apart in some projects.

It remains common practice to build demountable models and photograph them, exposing the various assembly and disassembly strategies used, such as photographs of assembly sequences, views of the model being opened, the hand holding the dismantled model, unfolded dismantled parts, among others (Figure 4). These photographic sequences derive from the very nature of the models, providing graphic evidence that “they cannot be reduced to mere instruments of the architectural process, but are themselves the product of an architectural or artistic process. (...) their essence extends beyond their purely representative nature” (Holtrop et al., 2011, p. 20).

These specific ways of photographing and conceiving the demountable model are shown to be an effective means of explaining the project, as they allow access to the interior or define its composition. Examples of modernity have continued, and the educational value of dismantling remains a common way of using models when designing or exhibiting a project. As a noteworthy reference, we highlight Buckminster Fuller’s Dymaxion House, which will be the work chosen for the cover of the exhibition *Efímeras alternativas habitables* (Blasco Rodríguez, 2011).



Figure 6: Constructed faces. a) Frei Otto; b) Shigeru Ban; c) Buckminster Fuller.
 a) Nerdinger (2005, p. 112); b) Warren King (2025); c) Buckminster Fuller Institute (s.f.). Hellman (2000, p. 21)



Figure 7: Demountable architectures. a) Works by the architectural studio Recetas Urbanas. Arranged in order: 1) Subversive strategies of urban occupation, 2) scaffolding, 3) institutional prosthesis, 4) insect house, 5) puzzle house, and 6) MAD.03. b) Shigeru Ban, Paper Pavilion Expo 2000 Hanover, Paper Partition System 4-Landslide in Hiroshima. Paper Emergency Shelters, 1995. Shigeru Ban, Bamboo Grid Shell Structures, 2004, and Wickerwork House, 2002. a) Recetas Urbanas (2026). b) Shigeru Ban Architects (2024). c) Shigeru Ban Architects (2024). d) Shigeru Ban Architects (2024). e) Shigeru Ban Architects (2024)



Figure 8: Similarities between construction toys from Juan Bordes' extensive collection and projects selected for the exhibition *Efímeras, alternativas habitables* (Ephemera, Habitable Alternatives). a) Juan Bordes: Tofilfried der Kleine Baumeister, unknown manufacturer, Germany, 1930s. Capsela Construction, Mitsubishi Pencil Co. Japan, 1983. Tensegritoy, A Geodesic Building Puzzle, Tensegrity Systems Corporation, 1990s. Dome Kit, Avlone Plastics, USA, 1975. Charles and Ray Eames, 1951. Stoks, Patent pending. Copyright 2008-2013. Bakausten Die Neu Raumelemente-Bauweise, Kari, Germany, 1960s. Der Kleine Grosseblock Baumeister. Plaspi. Germany, 1960s. a) Projects selected for the exhibition *Efímeras, alternativas habitables* (Ephemera, Habitable Alternatives), 2001, May 17-19. Ministry of Public Works. Madrid, taken from Paper Log House, 1995, by Shigeru Ban. Villa Rosa, 1967-68, by Coop Himmelb(l)au/Tree Tents, 1998, by Dré Wapenaar. Camping Tent, 1930-31 by Eileen Gray and Jean Badovici. Antartic Village/ No Borders. Ephemeral Installation in Antarctica, 2007, by Lucy+Jorge Orta. Institutional Prosthesis, 2004 by Recetas Urbanas. a) Bordes (2012), Socks Studio (2025), b) Eames Office (2021), Arquitecturas Efímeras (s.f.)

The Dymaxion House "starts from a suggestive and optimistic idea: there are other ways of building (with cardboard, with plastic), other housing proposals (easy and quick to make, removable and cheap) and other philosophies of life" (Díaz de Tuesta, 2011).

A prototype of a prefabricated, autonomous house, a machine for living (Montaner, 2002):

Beyond the aesthetically sophisticated prototypes of Le Corbusier and Mies were the futuristic and industrial prototypes created by Richard Buckminster Fuller (1895-1983), such as the Dymaxion (1928) and Wichita (1941-1946) houses, extreme forms of rationalist dogma, machines for living inspired by the efficiency and nomadism of objects related to the military world.

Without any concession to aesthetics, form, or style, it was exclusively mechanical and functional action that shaped buildings, which, like ships, airplanes, and automobiles, were entirely prefabricated and autonomous with respect to location (p. 88).

The prototype of the Dymaxion House, from 1927. It represents the first effort to construct an autonomous building during the 20th century. The project is based on a single-piece central vertical stainless steel strut through which the installations also pass. The roof and radial beams supporting the floor hang from this support. It represents the first effort to construct an autonomous building during the 20th century (Blasco Rodríguez, 2011). The assembly/disassembly strategy and the photographs of the Dymaxion House model (Figure 4) are a good example of the qualities of a model designed with a didactic breakdown, resulting in a well-conceived demountable architecture.

Dymaxion House is an excellent lesson, a good reference on how to design and photograph a model: "the model concretizes and externalizes ideas: the often tiny scale of the model and the external position of the observer in relation to it invite and allow the identification and evaluation of aspects that would otherwise be lost" (Pallasmaa, 2012, p. 61). It is clear that, with proper disassembly, these ideas will be better exposed.

The intention is not to overvalue the model or to place it above other means of architectural representation; a good coexistence between drawing, model, and photography, between the analog and the digital, is what is relevant. Regarding the educational use of models, we cannot fail to recognize the truth in this assessment by Helio Piñón (2009):

The decline in the ability to represent architecture graphically increased the difficulty with which students described the simplest aspects of their projects, which probably proved to be a determining factor in the popularity of physical models—models and other tangible objects—achieved in recent decades. This has made it clear that, among architecture students—and among architects—the ability to tinker is more widespread than the skill to describe graphically (para. 10).

The model is an effective way to learn architecture. Regarding its didactic application, between confronting or converging on the use of various means of architectural representation, we opted for the latter. While aware of the important role of other systems, incorporating the model as a training activity does not necessarily entail their suppression or undervaluation. The cases presented here demonstrate this, as well as an optimized combination of different systems of representation.



Figure 9: Educational experiences. Playing with the Eames' "House of Cards." Construction of detachable models of works by Eero Saarinen, MVRDV, or the Eames. (2024)

3.3. Demountable architectures

We can look at some architects whose work is generally associated with terms such as prefabrication, ephemerality, assembly, and disassembly: Buckminster Fuller, Frei Otto, Pérez Piñero, and Shigeru Ban are clear examples. In their work, we see the recurring use of models, mock-ups, and prototypes to generate their projects associated with the terms mentioned above. Their different architectures confirm qualities already mentioned in some of the previous quotes, such as: "The model and its playful nature, another piece in the toy box, the artist's toy", which is perfectly applicable to all these architects. To confirm this, one needs only look at the photographs in Figure 5, in which Buckminster Fuller, Pérez Piñero, and Alexander Graham Bell seem to be playing, having fun with their models, in similar situations where it is difficult to determine the boundaries between architecture and play. Their imaginative and even amusing poses clearly remind us of toys. The architects are portrayed with, in front of, on top of, or inside models with which they experiment and create their architectures, immersed in an apparently playful activity that is not at odds with the seriousness of their products.

Further confirmation of the playful nature of architectural models and dismantled structures can be found in the curious portraits of Frei Otto, Shigeru Ban, and Buckminster Fuller, whose features have been reconstructed using components from their demountable structures (Figure 6). Their *prefabricated and demountable* faces are assembled like construction sets, evoking their own models, which are equally *prefabricated and demountable*, and with which they will rehearse their experimental productions. Frei Otto, Piñero, Buckminster Fuller, Cirugeda, and Shigeru Ban are different, even radically different, authors, but they are brought together here by prefabricated, mountable, and demountable architecture and the frequent use of scale replicas.

The images in Figures 5 and 7 show a selection of models and prototypes that provide an overview of these architects' approach to demountable architecture. It is a diverse selection that focuses on what they have in common: testing and experimenting with models before bringing their alternative architectures to fruition. Their models are not miniature or full-scale replicas representing a defined project; their architecture is generated with them. They are objects for preliminary testing, necessary tools for determining the final form. The images converge in attitudes, poses, and common uses of the model. They are portrayed with them, manipulating them, assembling them, and disassembling them. The sequences of frames by Pérez Piñero, Frei Otto, and Buckminster Fuller, the posing in front of the models, and the "how to assemble" series recall the article's first images, of play and toys. Their personal architectures could also be described as playful, as Arnau (2000) points out:

Play is a form of representation (...) Play is an active and representative form, free and loaded with meaning, which invites the architect to provide a response that is equally playful, imaginative, and appropriate to its instances (p. 138).

Indeed, in all these cases, the architecture and models are appropriate to their instances. Looking at these images, we agree with Montey's (2000) considerations on the relative interest of the finished model, as opposed to its decisive intervention in the creative process, which is clearly reflected in these snapshots:

Undoubtedly, the finished model is of relative interest. Once it is completed, it loses all the potential that was generated during its construction. The vicissitudes of the model's construction are the most interesting part of this work.

As we scale up, the decisions about how to build a model become more complex.

This analytical dissection, which allows us to isolate specific elements, has moments in common with both studying and building. And it could lead us to say: If you want to study a building, build it! (p. 20)

The analytical dissection pointed out by Montey (2000) will be clearly reinforced by an adequate breakdown of the model's components. Indeed, a well-designed model will always involve a prior study of the building and a strategy for its construction, which will also involve planning an adequate set of pieces to be assembled to bring it to life. Photographing this process is an excellent educational practice for students.

As noted, the demountable model will have two distinct conditions in teaching practice: its design, deciding how it will be dismantled, and how to photograph it, to leave evidence of the effectiveness of that dismantling. These architects are an excellent example of this dual teaching condition, and having them as references greatly enriches and facilitates learning.

4. Results, discussion, and conclusions

These educational dismantling processes and demountable architectures constitute an extensive and dynamic field of study in which experimentation is a constant, and new ideas are developed in real or utopian projects. They form a pathway for the development of projects that are ahead of their time in terms of construction techniques, ways of living, and new relationships with the place in which they are inserted. In all of this, the essential roles of the model, mock-up, and prototype will be constant presences in practically all of them. We would like to highlight



Figure 10: Teaching experiences, construction of demountable structures. a) Temporary structures built by students and teachers in an experience coordinated by Nomad Garden in 2022. b) Construction of a geodesic dome in the architecture school by students. Workshop to promote architecture studies for primary and secondary school students. a) Nomad Garden (s.f). b) Autor (2024)

the playful nature of these projects, the rigorous play with these objects that leads to a great diversity of different proposals. Honestly playful architectures (Arnau, 2000):

Honestly, playful architecture is that which promotes a healthy, playful life. It is not that which appropriates playful characteristics that are repugnant to its condition as an economic, solid, useful, and beautiful object (p. 140).

Proof of this can be found in the images chosen for this article, in which the boundary between play and architectural design is blurred, common attitudes among architects playing with their models, and numerous construction sets of pieces that can be assembled, mounted, and dismounted. Figure 8 groups games and architectural elements by some similarity, showing situations and objects from both fields that appear similar. Alternate images from the exhibition *Ephemeral Alternatives for Living and Construction Games*. Stacking, connectors, couplings, screws, bars, and knots link these educational breakdowns. Games, models, prototypes, mock-ups, and demountable architectures brought together in a joint vision, demonstrating a common attitude: playing at building in children, playing at designing in architects.

The big game is yet to come: all static and immutable elements must be avoided, while the variable and mutable nature of architectural elements is a prerequisite for flexible relationships with the actions that take place within them. (Constant Nieuwenhuys, 1957 in Blasco Rodríguez, 2011, p. 14)

In the development of educational activities around demountable architecture, a few selected actions serve as examples. Games, models that can be taken apart, and the assembly of architecture have been experimented with in various subjects at different stages of education, ranging from introductory courses to more advanced ones. The experimental nature of these activities, together with a certain playful element, facilitates the learning of complex issues. Although very different in conception and scale, all these activities, whether individual or group-based and involving demountable structures, always produce satisfactory results and achieve a high level of student involvement.

In the teaching activities carried out at our school, various actions have been proposed regarding demountable architectures, which are illustrated in Figures 9 and 10, among others: designing how to build and subsequently materialize demountable models of works by various authors, such as the Eames, Saarinen, or MVRDV; playing with the Eames' *House of Cards*, which allow for a wide range of variations; and designing, on a real scale, ephemeral architectural installations or building a geodesic dome, after analyzing emblematic works such as those by Shigeru Ban or Buckminster Fuller. These actions encourage a return to basic operations in architectural design, such as weaving and covering, assembling, modeling and molding, cutting and stacking, using hands and bodies. Leading architects such as Le Corbusier, Rietveld, Mies, and Aalto have already experimented with them:

When architects emerged as professionals rather than craftsmen, they stopped working with their hands. They began to control construction indirectly through numbers and geometry, proportions and layout, and later through drawing as a system of graphic representation. But every true architect has continued to imprint on their works that condition of material creation, of working with materials, which gives their buildings consistency and constructive verisimilitude (Cortés, 2000, p. 1).

All of them, to varying degrees, allow us to actively reflect on issues such as those raised by Blasco Rodríguez (2011) on ephemeral and demountable architecture:

Transformation, speed, economy, lightness, recycling, standardization, mobility, storage, austerity, sustainability, temporality... are values that are increasingly identifiable with architectural and social reality, and Ephemeral Architecture, by its very definition, is one of the most appropriate expressions for adapting to these new values (p. 14).

With didactic breakdowns, we can work with theoretical concepts such as "bust and skin", proposed by Langarita and Navarro (2015), tectonicity, defined as the adaptation of material to form (Piñón, 1998), or study "the avant-garde culture of the fragment, which involves forms based on the accumulation, inclusion, and articulation of isolated parts that maintain their own autonomy in the final work" (Montaner, 2002, p. 186).

A demountable model, a construction set, and demountable or ephemeral architecture are distinct concepts with distinct approaches, depending on how they are viewed. However, they all share a common feature: they are demountable, and special attention is paid to the dismantling of their components. We can therefore bring them together in the same study, without attempting to force unique interpretations or other types of relationships. The object of interest is simply to generate reflections on the dismantlable, the dismantling in architecture, and the training of the architect. It is also evident that a dismantlable model, a construction set, and dismantlable architecture share the ability to generate multiple complementary actions and aid in the understanding of architectures with diverse conceptions and from different historical moments. Dismantling and disassembly shape the argument that allows these resources to be brought together, whose versatility and ability to combine numerous options will also enable us to approach a variety of architectures.

In short, these educational breakdowns and learning proposals with games, models, prototypes, and collapsible architectures are a field open to multiple educational facets. We can see them as "provocateurs of experiences" (Bordes, 2012, p. 59) among architecture students, as resources integrated into a complex pedagogical process that must necessarily be characterized by quality, rigor, and academic excellence. In a fundamentally digital environment, these analog resources can be incorporated as instructional supplements that embody Alba's (2018) assertion about the ability of play to generate an environment conducive to learning, accompanying the obligatory order of perceptions and conceptions common in education and opening it up to the other, the invented, the imagined, the previously imperceptible and inconceivable, to make concepts easier to understand and promote and spreading work attitudes at introductory and advanced levels (Bravo de Laguna, 2021).

As noted, we have chosen to show a variety of teaching activities whose common link is dismantling, so the results are not limited to each of the activities presented. We can say that the results are generally very satisfactory, with students becoming actively involved in the processes. This is the main incentive: real, shared activity that allows them to learn by building with different materials and at different scales, providing a useful introduction to the profession of architecture. The combination of seriousness and fun, learning and play, in participatory activities in which teaching is shared, and productive links are created among all members of the educational community, is noteworthy.

The activities are carried out at different stages of training, and in some cases, different levels are even intermingled, as in the construction of geodesic domes or ephemeral architectures. There are also individual activities, such as dismantlable models or the use of construction sets. The combination of individual and group activities allows for a weighted assessment of the student, activating different ways of approaching an architectural activity. Ultimately, the main objective is to develop effective ways to learn architecture, one of which is guided dissection to gain a good understanding of its components.

We can conclude that approaching educational dismantling at different scales and through different actions opens up a wide range of possibilities. As an added value, the resources discussed could also facilitate approaches to architecture for people outside the field, in workshops open to general participation. Educational dissections have proven capable of providing knowledge of varying degrees of complexity. They can be applied to other fields by leveraging their playful nature through games, models, prototypes, mock-ups, and collapsible structures accessible to the general public. After all, as Bordes (2012) points out, "developing a creative and architecturally structured mind is desirable and useful for all professions" (p. 59), and games and playful activities that draw on these resources are a means of fostering this development.

Educational cutaway models and demountable structures constitute an open and dynamic pedagogical field. The experiences described above allow us to make a series of statements:

- Student participation, through manual activities and materials, reinforces their architectural understanding.

5. Bibliographic references

- The combination of play and rigor allows complex concepts to be approached in an accessible and creative way.
- Models, mock-ups, and games are complementary resources to drawing and digital media, and are not mutually exclusive.
- These activities can extend beyond formal education and involve the community or audiences outside the field of architecture.

As a final reflection, we could modify and expand on the initial question posed by Mazzanti at the beginning of the article: "What would happen if we played with construction games at school, designed models that can be taken apart or removable and ephemeral architectures, with which students and teachers could actively organize teaching according to the topics or research they are carrying out?" We could give multiple, versatile, and stimulating answers to that question, such as a responsible teaching activity that integrates well-planned educational dismantling, proposing actions with games, models, prototypes, and removable architectures, in the constant search for better teaching.

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