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# DETERMINANTS OF EXPERIMENTAL HOUSING FORMS IN THE HISTORY OF ARCHITECTURE OF THE 20TH AND 21ST CENTURIES*

# DETERMINANTY KSZTAŁTOWANIA EKSPERYMENTALNYCH FORM MIESZKANIOWYCH W HISTORII ARCHITEKTURY XX I XXI WIEKU

Abstract

The author's objective is to define the most important determinants of the development of experimental concepts for multi-family buildings in the 20th and 21st centuries. The analysis demonstrates that the determinants of such structures are multi-level: ideological, architectural, social, economic, technological, and ecological. Understanding their synergies is crucial for design processes. The analysis resulted in a framework for the development of experimental housing forms. The analysis was carried out based on selected examples.

*Keywords: residential architecture, determinant, experiment, form*

Streszczenie

Autor stawia za cel rozważań zdefiniowanie najważniejszych determinantów powstawania eksperymentalnych form obiektów wielorodzinnych w 20. i 21. wieku. Analizy wykazały, że determinanty kształtowania takich struktur są wielopoziomowe – ideowe, architektoniczne, społeczne, ekonomiczne, technologiczne i ekologiczne. Zrozumienie ich synergii jest bardzo ważne w procesie projektowania. W wyniku analizy powstał schemat rozwoju eksperymentalnych form mieszkaniowych. Analizę przeprowadzono w oparciu o wybrane przykłady.

*Słowa kluczowe: architektura mieszkaniowa, determinanta, eksperyment, forma*

## 1. INTRODUCTION

Experimentation in residential architecture has always been important, guiding the design of individual architectural forms as well as larger structures. Residential architecture—though pragmatic by nature—has been a field of intense formal, material, and social

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experimentation over the past hundred years. The twentieth century brought the modernist revolution, which broke with historicism and advocated a functional approach to design. The twenty-first century, however, is an era of technology, ecology, and spatial flexibility. Experimental residential buildings, though often marginalized by mainstream construction, serve as laboratories of urban planning and architecture—testing new spatial solutions, materials, and social models. The analysis presents the key determinants influencing their development. Contemporary residential architecture constantly seeks ways to break established patterns by integrating modern technologies, sustainable development, and innovative ways of utilizing space. Experimental multi-family and single-family buildings, as architectural laboratories of sorts, are not only showcases of creativity but also determinants of trends that are gradually permeating the broader housing sector. They distinguish themselves from traditional structures primarily through their willingness to push the boundaries of conventional solutions. Architects working within these projects take the risk of implementing innovative technologies, materials, and unusual forms. They often become examples of testing design hypotheses, which—thanks to the flexibility of the concept—allows for the subsequent implementation of proven solutions in residential projects. Experimental multifamily buildings often redefine the concept of living space. Innovative design solutions, such as flexible room layouts, multifunctional zones, and modular systems, enable the creation of spaces that can be easily adapted to changing user needs. Currently, the use of new technologies and creative solutions also contributes to improving the energy efficiency and environmental performance of buildings. The implementation of intelligent control systems that automatically respond to changing external conditions is becoming an example of how experimental designs can become the foundation of modern architectural concepts.

## 2. PURPOSE AND METHOD OF RESEARCH

The research aims to define and characterize the determinants of experimental concepts for multifamily buildings in the 20th and 21st centuries and the impact of such experiments on the development of residential architecture. Understanding their synergies is important in the context of designing contemporary residential environments and individual buildings. The analysis resulted in a framework for the development of experimental housing forms over time. The author also raises questions about current conditions that significantly impact the feasibility of implementing buildings and multifamily housing structures, including the question of possible experiments and innovations in housing. The author uses a multi-criteria analysis based on a set of selected implementations and designs of multifamily buildings and complexes. The criteria for experiments in housing can range from ideas and the search for architectural, spatial, structural, material, and functional solutions to technological and ecological innovations. In selecting the criteria for experiments in residential projects, the author utilized, among other things, insights from research on experiments and innovations in architecture conducted by architect J. Słyk[1].

[1] J. Słyk, *Eksperymenty budownictwa i architektury. Ku metodzie naukowej w sztuce budowania*, "Builder" 2020, no. 8, pp. 9–13. DOI: 10.5604/01.3001.0014.2767.

## 3. DETERMINANTS OF EXPERIMENTAL MULTI-FAMILY FORMS OF MODERNISM IN THE 1920S–1950S: IDEAS, PROGRAMS, SOCIAL ASPECTS

Prewar modernism in architecture, particularly during the interwar period (1918–1939), was a response to the dynamic social, technological, and cultural changes taking place in Europe and worldwide. After World War I, an urgent need arose to build modern, affordable, and functional housing for the rapidly growing urban population. Modernist ideas in residential architecture were based on functionalism, simplicity, and the social responsibility of architecture. The author believes that the ideological and technological assumptions of modernism in housing can be considered key determinants of future experiments in housing in the first half of the 20th century.

*Functionalism***.** Louis Sullivan's slogan "form follows function" became one of the foundations of modernism[2]. Architects strived for maximum usability of space, avoiding unnecessary decoration. The apartment was intended to serve the everyday needs of life—to be ergonomic, well-lit, and airy.

*Standardization and prefabrication***.** Due to the enormous housing needs, technologies for the production and implementation of repeatable modules and prefabricated elements were developed, which was intended to reduce construction costs and shorten implementation times. Modernist architecture assumed rational design, also from an economic perspective.

*The democratization of housing***.** Housing was not intended to be a luxury, but a right of every citizen. Modernist architects wanted to design for the "masses"—workers, officials, teachers. Hence the ideas of affordable social housing and housing estates accessible to broad segments of society.

*Modern technology and materials***.** Modernists eagerly embraced modern materials: reinforced concrete, steel, and glass. New technologies allowed for the creation of more spacious and well-lit interiors than traditional construction.

*New types of apartments and estates***.** Traditional tenement houses were abandoned in favor of terraced, point-based, or linear development. Apartments were designed with access to daylight, ventilation, and greenery. So-called garden estates were created, estates with green spaces and full social infrastructure (schools, shops, playgrounds). The foundations of modern housing estate design for the interwar period were defined, among others, in the fundamental document of modernism – the Athens Charter, as well as in the concept of the neighborhood unit and the idea of the social housing estate[3].

*Social and cultural aspects***.** Modernism in residential architecture was not only an aesthetic movement but, above all, a social one. The rejection of historical styles and the pursuit of creating housing for all meant a shift in thinking about the city, about people, and their needs. The user – the average resident – was at the center, with comfort and health as priorities. Prewar residential modernism revolutionized the way architecture was perceived as a tool for social change. The ideas of functionality, simplicity, standardization, and accessibility set new standards in residential design. Although many of the projects of the time were experimental, their influence is still felt today – in the concepts of modern housing estates, urban planning standards, and approaches to designing living spaces.

Examples of successful experimental housing estates from the early modernist period include the Britz Estate in Berlin (architects M. Wagner and B. Taut, 1925–1933),

[2] D. Watkin, *Historia architektury zachodniej*, Arkady, Warszawa 2006, p. 557.
[3] *Ibidem*, p. 534.

the Siemenstadt Estate in Berlin (architects H. Scharoun and others, 1929–1934), and the Karl-Marx-Hof complex in Vienna (architect K. Ehn, 1927–1930). Each of these projects is distinct in its aesthetic, but each was created in response to the large-scale programs for building workers' housing implemented in the 1920s and 1930s. Each of them has become a model and inspiration, both in terms of architectural, spatial and programmatic concepts, details used and material and color solutions.

A quintessential European-scale experiment is the Weissenhof estate in Stuttgart (1927), designed by leading modernist architects (including Le Corbusier, Mies van der Rohe, and others). A similarly influential experiment, in terms of scale, was the Hansaviertel estate in Berlin, built as part of the Interbau '57 world architectural exhibition. Fifty-three architects from 13 countries were invited to participate, including Le Corbusier, Oscar Niemeyer, Alvar Aalto, Walter Gropius, Arne Jacobsen, and others. Their projects created a quintessence and catalog of residential architectural forms from the post-World War II modernist era. In Poland, a successful experiment of early modernism was the WSM estate in Żoliborz, which served as a model for modern, democratic, and functional housing.

Experiments in twentieth-century residential architecture were often ideological. Modernists like Le Corbusier advocated for a "machine for living"—an optimized, rational, and devoid of ornamentation space. Experiments like the Unité d'Habitation (Marseille, 1952) combined functionalism with an attempt to redefine the residential community. The building was no longer simply a shelter but a microcosm of society, complete with services, a school, and a rooftop garden.

It was here that Corbusier left a raw, unplastered concrete surface. The Marseille unit, with its 337 apartments, took five years to build (repeated in Nantes, Berlin, and Meaux), both admired and criticized for its structure and apartment solutions, had a profound impact on residential architecture. Concrete has remained a permanent fixture in housing, primarily due to its structural capabilities, its use in facades, as well as its fire safety and the ability to mass-produce prefabricated elements. Polish counterparts of this new philosophy of multi-family housing were also developed under Corbusier's influence. Corbusier's famous five principles—the load-bearing column, the functional independence of the frame and walls, the "libre plan," the free-form façade, and the roof garden—became mandatory design principles in the following decades[4]. As architect K. Kucza-Kuczyński writes, "Today's concrete, together with steel, glass, wood and stone, is the basic alphabet of contemporary materials, co-creating the landscape of modern architecture"[5].

## 4. DETERMINANTS OF EXPERIMENTAL HOUSING FORMS OF THE 1960S AND 1970S: MANIFESTOS, MOBILE AND ADAPTIVE STRUCTURES, TECHNOLOGIES, CREATIVE EXPLORATIONS

The 20th century was a time of experimentation on an unprecedented scale. After two world wars, the need for mass construction determined the directions of development. Overpopulation, urbanization, a lack of raw materials, and the need for mobility were certain

[4] K. Frampton, *Modern architecture*, Thames & Hudson, London 2007.

[5] K. Kuczy-Kuczyński, *Beton w architekturze mieszkaniowej*, XIII Konferencja Dni Betonu „Beton na progu nowego milenium", Wisła 13–15 października 2025, p. 4, https://www.dnibetonu.com/wp-content/pdfs/2000/02/kucza-kuczynski.pdf (access: 15.10.2025).

determinants of further housing experiments in the 1960s and 1970s. In this context, it is impossible not to mention the influence of architectural theories and manifestos. Archigram, Superstudio, and Cedric Price proposed a complete break with the classical understanding of the home. The building was intended to be temporary, modifiable, and portable. Such visions, although often left on paper, sowed the seeds of a revolution, which is visible today in the ideas of 3D-printed houses, residential containers, and open-source architecture. Archigram and the Metabolists in Japan proposed adaptive, mobile, and modular structures, such as the Nakagin Capsule Tower (Tokyo, 1972, Kisho Kurokawa)—a building with interchangeable residential capsules[6].

Although many of these projects remained on paper, they left a lasting mark on the concept of flexibility and prefabrication. Prefabrication was seen as a solution to housing problems also faced in Western countries such as France, Germany, and Austria. Such systems began to be developed, a striking example of which was the experimental housing structure Habitat'67, designed by the Moshe Safdi architectural studio and presented at the 1967 Montreal EXPO. Its modular design, based on modular, prefabricated elements, enabled the integration of private living spaces with open-plan communal areas. Habitat'67 became the inspiration for many contemporary solutions, combining flexibility of form with functionality.

Housing developments in Poland in the 1960s were primarily a response to the severe housing crisis that had plagued the country since World War II. The communist authorities sought to meet the needs of the growing urban population through mass housing construction. This period also saw attempts at more innovative and experimental solutions—both architectural and social. In the late 1950s, during the post-Socialist Realism thaw, modernist ideas returned, resulting in original, experimental and unique housing designs in the 1960s. These include, among others: Słowacki Housing Estate in Lublin (architects: Zofia and Oskar Hansen, design 1960–1963), Przyczółek Grochowski in Warsaw (design 1963, construction 1969–1974), Superjednostka in Katowice (architect M. Król, 1970), Sady Żoliborskie Housing Estate (architect H. Skibniewska, 1960–1963) or Za Żelazną Bramą Housing Estate in Warsaw (architects: J. Czyż, J. Furman, A. Skopiński, J. Józefowicz, M. Bieniewski, S. Furman, 1965–1972)[7], etc.

Zofia and Oskar Hansen's experimental housing estates, Osiedle Słowackiego in Lublin and Przyczółek Grochowski in Warsaw, are attempts to implement the idea of "Open Form"—an architectural concept that allows residents to individually customize their spaces. The goal was to create a space that would facilitate social integration and flexible use of space. Architect Halina Skibniewska was the first in Poland to implement the flexible housing model in her design for the Sady Żoliborskie estate. The estate is composed of repetitive, low-rise three- and five-story buildings (24 in total, including 18 five-story buildings and one eleven-story building on the outskirts).

The buildings' distinctive layout is striking. Scattered seemingly haphazardly among the greenery, they create smaller, intimate spaces. Due to the imposed standards, the apartments were small, yet designed in a way that was accessible to residents. The development of the apartment layouts is noteworthy. H. Skibniewska designed movable wall units that allowed residents to arrange the interiors according to their preferences. Unfortunately, due to the high production costs of such elements, they were only featured in the prototype building; subsequent buildings

[6] C. Jencks, *Ruch nowoczesny w architekturze*, WAiF, Warszawa 1987.

[7] T. Szafer, *Nowa architektura polska. Diariusz z lat 1966–1970*, Arkady, Warszawa 1972.

utilized ordinary partition walls. Nevertheless, it was a successful experiment— both in terms of the spatial layout of the estate and in terms of the so-called flexible apartment layouts.

Many projects were inspired by Le Corbusier's concept of the "housing unit," but were transformed in a socialist spirit, sometimes due to budget constraints. Examples include the Superjednostka (Super Unit) in Katowice and the Za Żelazną Bramą (Behind the Iron Gate) housing estate in Warsaw (a widely criticized experiment, but scaled back for financial reasons). It's also important to note that many projects from that period were social and urban planning experiments of their own. There were attempts to create self-sufficient housing estates with full social infrastructure (schools, shops, clinics, community centers), as well as attempts at large urban units with pedestrian and vehicular segregation (e.g., housing estates in Warsaw's Ursynów district, and the residential and commercial development at Grunwaldzki Square in Wrocław). An innovative experiment on a global scale, due to its original construction design, was the project of the "trzonolinowiec" (residential building) in Wrocław (designed by A. Skorupa and J. Burzyński, 1967). In summary, housing experiments in Poland in the 1960s were the result of:

- enthusiasm for modern forms and technologies,
- attempts to reconcile functionalism with the realities of a planned economy,
- attempts to create community through space (sometimes unsuccessful),
- the transformation of utopian ideas into the grim reality of the Polish People's Republic.

The 1970s in Poland saw the dominance of prefabricated technologies in the implementation of housing projects, which can hardly be called architecture; rather, the period could be described as "technologism." The 1960s saw the development of large-panel construction, intended to speed up the construction process (the first prefabricated building in Poland was built in Jelonki in 1958). Experiments were conducted with various systems, such as the OWT-67 (Technology Standardization Center). Some estates were built as "experimental testing grounds," where various construction technologies were tested, such as different types of walls, finishing installations, etc. Compared to Polish attempts at prefabricated housing in the 1960s, the "Służew nad Dolinką" estate in Warsaw (architects J. Kuźmienko, J. Nowak, and P. Sembrat, 1965–1975) deserves a positive assessment. The project became famous for its unique "H" frame system and its distinctive, highly successful prefabricated spacious balcony terrace. This prefabricated detail became a hallmark of the development and was also used in other projects[8].

Large-panel prefabrication and standardization in the 1970s led to a serious regression in architectural solutions in multi-family housing in Poland (aesthetic beauty was not taken into account). For many years, housing factories halted creative considerations and attempts to prefabricate elements for architectural realization and prefabricated detail.

## 5. DETERMINANTS OF THE EXPERIMENT OF THE POSTMODERN PERIOD: THE SEARCH FOR A NEW AESTHETIC

Postmodernism in architecture, which emerged in the 1960s and 1970s as a reaction to the austerity and functionalism of modernism, was particularly evident in residential design. This architecture, replete with irony, quotations from the past, contrasts, and play on form,

[8] T. Szafer, *Nowa architektura polska. Diariusz z lat 1976–1980*, Arkady, Warszawa 1981.

introduced a completely new approach to space, detail, and communication with the user. Postmodernism rejected modernist dogmas such as "form follows function," the absence of ornament, and the universality of form and detail. Instead, postmodern architects sought to play with convention, introducing quotations from classical styles, and a certain aesthetic pluralism. In residential architecture, postmodernism created room for experimentation, in which form began to play an equal role to function.

This was manifested, among other things, through:

a/ diverse styles—architects began to draw elements and details from various eras (e.g., columns, arches, pediments, etc.), from Classicism to Baroque, often combining them ironically or symbolically; architecture became full of symbols, metaphors, and quotations from earlier eras;

b/ unusual geometry and color—including overscaled details, refractions, vibrant colors on facades, and colorful details were used; color was no longer neutral, and shape also served a playful purpose;

c/ typological diversity—apartments were created with diverse spatial layouts, abandoning the repetitive modules typical of Modernism; urban layouts often employed irregular plans with internal courtyards and pedestrian paths, and a return to classical urban frontage solutions.

Although postmodernism was sometimes criticized for its superficiality, eclecticism, and lack of cohesion, it led to important consequences in housing:

- a shift away from the anonymity of apartment blocks,
- a sensitivity to cultural and historical context,
- the diversification and humanization of living spaces.

Postmodernism in residential architecture was an experiment in form that shattered modernist dogma and opened architecture to a dialogue with the past, context, and user. Although its aesthetics are sometimes controversial today, its influence on the development of architecture is undeniable.

While there are few experimental modernist housing projects around the world, they are highly distinctive. Undoubtedly, these include the works of architect Ricardo Bofill, such as Walden 7 in Spain (a complex with an extremely intricate spatial structure of apartments, an experiment in communal and private spaces) and the Les Espaces d'Abraxas complex located in Noisy-Le Grand, 15 km from central Paris. This outstanding postmodern work, completed in 1982, contains very clear visual references to ancient architecture[9].

Experimentation with postmodernist forms in residential architecture can be identified in the projects of the Berlin IBA, which opened in 1987. The architectural works of Peter Eisenman, Zaha Hadid, Rem Koolhaas, Rob Krier, Aldo Rossi, James Stirling, and other artists involved in the renovation of Berlin's city quarters display distinct attributes of experimental forms, primarily in the shaping of details and facade compositions.

In Poland, postmodernist housing experiments were few, but it is worth mentioning the Centrum E housing estate in Nowa Huta (architect R. Loegler, 1988–1995) and the infill buildings in Wrocław by architect W. Jarząbek from the late 20th century, which have become a permanent fixture in the development of Polish architecture.

[9] J. Tietz, *Historia architektury XX wieku*, Könemann, Köln 2001, p. 86.

## 6. DETERMINANTS OF THE END OF THE 20TH CENTURY – CRISIS OF IDEAS, SUSTAINABLE DEVELOPMENT, SOCIO-ECONOMIC CHANGES

The end of the 20th century in housing was a time of crisis of ideas in architecture and urban planning. Widespread criticism of modernism, which led to a crisis in urban planning in many cities, the energy crisis of the 1980s, somewhat unsuccessful experiments with prefabricated technologies, the prospect for the depletion of natural resources, and ongoing social changes in the context of economic development, sparked much discussion about the further development and formulation of, among other things, the term "sustainable development" and its principles.

The concept of sustainable development is rooted in reflection on the effects of intensive economic and industrial development, which began particularly in the 20th century and came to have a negative impact on the natural environment, society, and the economy. The 1960s and 1970s saw the beginnings of environmental awareness. The negative consequences of industrialization began to be recognized: air and water pollution, environmental degradation, and overexploitation of natural resources.

The first global conference on the environment—the United Nations Conference on the Human Environment—was held in Stockholm in 1972. It drew the world's attention to the need to combine economic development with environmental protection. The official definition of the concept of "sustainable development" appeared in the Brundtland Report in 1987—"Our Common Future," a report published by the World Commission on Environment and Development chaired by Gro Harlem Brundtland. The concept was defined as: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"[10]. Another important event in the practical implementation of sustainable development was the 1992 Earth Summit in Rio de Janeiro, organized by the United Nations. This summit adopted, among other things, Agenda 21—a global program for collective action.

Sustainable development in housing is an approach that combines environmental concern, economic efficiency, and social well-being in the design, construction, and operation of residential buildings. The goal is to create living spaces that are friendly to people and the environment while minimizing resource consumption. The main pillars of sustainable development are: environmental (energy efficiency, eco-friendly materials, water management, green infrastructure), social (housing affordability, social integration, safety), and economic (including cost-effectiveness, ease of adapting housing to changing needs, etc.). Since the late 20th century, sustainable development paradigms have become the main factors determining the design of new housing structures, as well as guidelines for the modernization and revitalization of older housing stock. This had an impact on the creation of pilot, sometimes experimental, projects and the implementation of residential developments in many countries in Europe and around the world.

One such experimental, comprehensive example is the Westerpark GWL Terrain housing complex in Amsterdam, also known as the "eco-car-free housing quarter". Planned on the site of the former Amsterdam Waterworks in 1993 by a team led by architect Kees Christiaanse and landscape architect Adrian Geuze, it became a significant experiment and, at the same time, a model, combining five principles of sustainable development during the design

[10] United Nations, *Our common future*, Report of the World Commission on Environment and Development, 1987, p. [37].

process: the selection of ecological materials, water management, energy management, wastewater management, green infrastructure, prioritizing pedestrian and bicycle traffic by significantly reducing the number of parking spaces (factor 0.3), and encouraging residents to use public transport. The development was planned on 6 hectares, with 600 apartments[11].

The interior of the large block was designed as a green space, with various forms of greenery completely filling the spaces between the residential buildings. A very high quality of the residential environment was achieved at a relatively reasonable cost. Another prime example of an experimental housing estate designed to be zero-emission was the BedZED complex, located near London after 2000 (architect B. Dunster). Ultimately, it turned out that not all design assumptions worked well in practice, and residents needed to be educated on how to use some of the pro-ecological solutions.

Among the large-scale experiments in sustainable development, it is worth mentioning the legacy of original residential designs inspired by the Graz School of Architecture in Austria in the late 20th century. Smaller projects dominate, but these are forms of exceptional scale, original architecture and detail, and idea-driven. Some of these are experiments in residential architecture, including the residential projects of the M. Szyszkowitz-K. Kowalski studio (forms inspired by insects), deconstructivist designs by architect G. Domenig, and finally the Wienerberger Housing Development complex by architects R. Erskine and H. Ries from 1987–1997[12]. This latter project, relatively little known, should become a model for multi-family housing for urban fringe areas, a model of sustainable development. The scale of the architecture, the urban solutions used based on the "Mediterranean village" scheme, greenery and water elements, the concepts of pedestrian routes and limiting vehicular traffic, as well as the great potential for implementing renewable energy solutions are great advantages for the design of housing structures in the 21st century.

## 7. DETERMINANTS OF EXPERIMENTS IN HOUSING AT THE BEGINNING OF THE 21ST CENTURY

### 7.1. IDEOLOGICAL DETERMINANTS: THE SEARCH FOR NEW ARCHITECTURAL FORMS

The crisis in residential architecture at the end of the 20th century, as well as the socio-economic transformation of Eastern Bloc countries in Europe, led to the emergence of a pluralism of forms in housing. In the eastern part of the continent, significant construction was carried out, the quality of housing projects improved, and urban revitalization efforts began. Meanwhile, in some Western countries, where the housing market was already saturated, in addition to investments in the spirit of sustainable development, experimental housing projects emerged in terms of architectural form. Such experimental projects can be seen, for example, in the work of design studios MVRDV from the Netherlands and Bjarke Ingels Group (BIG) from Denmark.

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[11] A. Tokajuk, *Two experimental housing concepts from Amsterdam: Comparative analysis*, "Architecturae et Artibus" 2022, no. 4, pp. 106–116. DOI: 10.24427/aea-2022-vol14-no4-08.

[12] P. Blundell-Jones, *Dialogues in time. New Graz architecture*, Haus der Architektur, Graz 1998.

MVRDV experiments with micro-villages, green spaces, and modular apartment layouts, seeking to combine privacy and community. For example, in the Digge Village project in Rotterdam (2006), the architects designed an example of a "rooftop village": a series of separate "dormitories" were built on a historic building, connected by shared streets and squares. The entire structure was covered with a blue skin that evokes the sky—a "heavenly" living space on the roof. Meanwhile, the 2017 competition design for La Serre for Paris proposed a garden building, where 111 apartments were arranged in a glass "greenhouse" wrap, creating a green, shared micro-ecosystem in springtime, encouraging community.

MVRDV also returned to Le Corbusier's "apartment puzzle" concept with an experimental approach: a building with a modular, diverse layout of apartments, a spatial solution that provides a sense of both privacy and community. Examples of such experiments can be seen in the Silodam projects in Amsterdam (2003) and Mirador (2005), and Celosia (2009) in Madrid. The Madrid projects are examples of collaboration with the local studio Blanca Lleo. Mirador Building can be compared to a vertical urban block—different parts stacked on top of each other, creating a large opening in the building—a kind of courtyard suspended in mid-air. Celosia is another transformation of the urban block. It is a composition of 30 smaller blocks, placed side by side and on top of each other like bricks. The blocks are arranged so that gaps are left between the volumes. These gaps are located at different levels and, from a distance, give the Celosia Building the appearance of a large piece of Swiss cheese. These gaps serve several functions: they provide sunlight and air to the apartments, and they also allow sunlight and wind to reach the courtyard, which is thus no longer a dreary well. Entrances to the apartments are located on the gaps. The architectural and communication solutions in the Mirador and Celosia buildings are undoubtedly experimental[13].

MVRDV's recent projects—The Valley in Amsterdam and Ilot Queyries in Bordeaux—also stand out for their unusual architectural forms. MVRDV consistently pursues the idea that residential architecture can be simultaneously functional, surprising, and socially responsible.

BIG operates on a larger scale: it introduces mixed-use projects (apartments and services), communal spaces—roofs and paths—and adapts them to the urban landscape (water, city). All these elements appear in experimental forms, including Mountain Dwellings in Copenhagen (2008), House 8 in Copenhagen (2010), and VIA 57 West in New York (2016). The first example is a parking garage with apartments: the multi-level garage serves as the foundation for the apartments, with a "garden" on the roof of each unit—like a micro-home on the slope of a sunny mountain. The second is a figure-eight-shaped structure combining apartments, offices, and services. The unique, sloping promenade roof, created on a ramp, facilitates neighborhood gatherings and walks without leaving the building. The New York project is an impressive pyramid in Manhattan—a form "between a skyscraper and a courtyard." Designed as an "urban island", it is characterized by the privacy of the apartments and an integrated interior space, in addition to its original form[14].

Both studios, MVRDV and BIG, are pushing the boundaries of housing: through the integration of nature, new modular typologies, and influencing urban intensification.

[13] MVRDV – Architects, https://www.mvrdv.com/ (access: 30.06.2025).

[14] BIG | Bjarke Ingels Group, https://big.dk/ (access: 30.06.2025).

### 7.2. SOCIAL DETERMINANTS: NEW MODELS OF COMMUNITY

A housing experiment is rarely an end in itself—it is most often a response to social changes. After World War II, numerous experimental projects were developed with cheap, fast, and mass construction in mind. Today, the flashpoints include the housing crisis in large metropolises and demographic changes (aging societies, the increase in single-person households). In response, new models of coexistence are emerging: cohousing, coliving, micro-apartments, and multigenerational homes. An example of a successful social experiment is the Sargfabrik project in Vienna (BKK-3, 1996)—a complex of apartments and shared spaces (e.g., swimming pool, kitchens, preschool) that redefines neighborly relationships.

The twenty-first century has also seen a return to the participatory project model, pioneered several decades earlier by L. Kroll and R. Erskine, among others. An example is Berlin's Spreefeld—an experimental housing development where users participated in the design and co-management of the buildings. Architecture ceased to be an imposed form and became a platform for community.

## 8. DETERMINANTS TODAY

### 8.1. TECHNOLOGICAL DETERMINANTS: DIGITALIZATION, PREFABRICATION, AND NEW MATERIALS

The development of technology in the second half of the 20th century and the explosion of digitalization at the turn of the century fundamentally changed the design process. CAD tools, and later BIM, enabled not only greater precision but also experimentation with form—while simultaneously controlling functional and energy parameters. Experimental housing in the 21st century is often the result of parametric and algorithmic design. An example is The Interlace in Singapore (OMA + Ole Scheeren, 2013), where blocks form a geometric structure resembling a hexagon[15]. Such a layout would not be possible without advanced computer modeling. Prefabrication also plays a significant role—now gaining popularity again thanks to CNC and 3D printing technologies. The Y:Cube Housing project in London (Rogers Stirk Harbour + Partners, 2015) is a system of prefabricated micro-apartments assembled on site in a matter of days[16].

In a similar vein, experimental structures are also being created using 3D printers, such as TECLA from the Italian company WASP—clay houses printed in layers on site.

### 8.2. ECOLOGICAL DETERMINANTS: REGENERATIVE AND BIOTECHNOLOGICAL ARCHITECTURE

The twenty-first century is also a time of climate crisis, forcing a complete rethinking of residential architecture. Experimental buildings are increasingly becoming zero-emission,

[15] *The Interlace* [in:] OMA, https://www.oma.com/projects/the-interlace (access: 10.06.2025).

[16] *Y-Cube / Rogers Stirk Harbour + Partners* [in:] ArchDaily, 11.09.2015, https://www.archdaily.com/773370/y-cube-rogers-stirk-harbour-plus-partners (access: 10.06.2025).

self-sufficient, and even regenerative. In the residential context, a pioneering project is Bosco Verticale in Milan (Stefano Boeri, 2014)—skyscrapers covered in greenery, whose vegetation performs microclimatic, acoustic, and psychological functions. Here, architecture enters into dialogue with the ecosystem, reducing urban heat islands and improving air quality.

More recently, biotechnological materials are emerging—from bricks grown from mycelium to facades infused with energy-producing microalgae. Such solutions are being tested by, among others, the MIT Media Lab and start-ups such as Biohm and EcoLogicStudio.

### 8.3. SOCIAL DETERMINANTS, IMPACT OF WARS, ECONOMICS

Today, many countries in Europe and around the world are facing a housing crisis, a crisis related to social and economic changes, changes triggered by the COVID-19 pandemic, and wars in Ukraine, the Middle East, and Africa. Each of these issues is becoming a determinant in shaping appropriate housing structures, dedicated to the appropriate target group. Significant social changes are occurring in many European countries due to demographic collapse. Very low fertility rates and aging societies are forcing the search for housing for seniors. Although it is difficult to speak of architectural experiments here (they are few, e.g., WoZoCo by MVRDV in Amsterdam, 1994), the design of various types of nursing homes, especially for people with various health conditions, is a topic bordering on interdisciplinary experimentation. On the other hand, in many European countries, the number of childless or single-child households is growing, for whom purchasing a larger apartment presents a significant financial barrier. Especially after the COVID-19pandemic, apartments on the Old Continent, but also in America, have become horrendously expensive, with inflation and mortgage costs rising.

Designing affordable housing for young people and families with children, and seeking affordable standards, is a form of experimentation today. Such trials are being conducted in various centers (including the Faculty of Architecture at the Bialystok University of Technology). However, developers are not particularly interested in such standards – the solution to the problem lies in the design of accessible housing, and this is where experiments are needed. It could be said that after 100 years, history has come full circle; societies once again need more affordable, accessible housing for lower- and middle-income workers. Wars raging around the world have led to large-scale migration, as well as disruptions in the supply of raw materials, primarily oil and gas, to European countries. This has rapidly accelerated energy transitions, the introduction of renewable energy sources, and changes in building heating systems and construction technologies.

## 9. SUMMARY

Experimentation in residential architecture was not, and is not, a luxury, but a necessity. Experimental multi-family residential buildings, although they constitute a small percentage of architectural projects worldwide, are an invaluable indicator of the direction in which the discipline is heading. Their form stemmed from the tension between the need for innovation and the need to address real social and environmental problems. Research has shown that the determinants of such structures are multi-level—ideological, architectural, social, economic, functional, technological, and ecological. In the twentieth century, the ideas

of modernism and economic conditions played a significant role in shaping experiments in housing, and the types of multi-family buildings and complexes, as well as living models, developed during this period are still used today.

The twenty-first century brought new determinants—a crisis of ideas and the search for new forms, paradigms of sustainable development, significant progress in the development of digital design tools, technological and material advances in construction, climate change, and finally, social transformations, wars, and migration. The design landscape has become more complex. It is important to remember that the creativity of visionary architects has always played a significant role in the creation of experimental forms. This is still important today, to better understand the synergy of all these determinants. Understanding their synergies is crucial if architecture is to meet the challenges of the twenty-first century while maintaining a human, ethical, and responsible dimension. The future will not happen by itself—we must design it.

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