Masters and teachers, housing innovations in designs of the professors of the Faculty of Architecture in the Warsaw University of Technology at the beginning of the 20th century

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Abstract. The Faculty of Architecture in the Warsaw University of Technology (FA WUT) was established in the first quarter of the 20th century, when in European architecture and art, traditional trends were intertwined with new ideas, which inspired building’s creativity. In 1915, the Society of Science Courses and the Association of Technicians attempted to create a Polish university and polytechnic in Warsaw. Finally, at the newly created technical university, an independent architectural faculty was established. The members of the Organizing Committee and future professors represented the diversity of the architectural environment, both thanks to the education in various European schools (polytechnics, military schools and art academies), as well as the different aesthetic interests. This diversity was fully reflected in the architectural creativity of that period. At the beginning of the 20th century, the traditional craft thinking turned into the scientific interpretation of spatial activities, which stimulated the interest in novelty. The innovation was understood as in humanistic disciplines - like the ability to discover and test the solutions which deviate from the standard and which induce a rapid change in quality. Innovations of this period took the form of abstract and realistic ideas, methods based on alternative sets of criteria and technologies. They concerned the urban and architectural scale as well as the detail. In the particularly demanding living environment design, they manifested themselves in many objectively new values, such as functionalism, social housing, extensive typology of dwelling layouts, innovative reinforced concrete constructions of open plans, new standards of insolation, ventilation and many others. The paper is a summary of analyses regarding modern thoughts about living, present in selected projects and realizations of FA WUT professors, 1918-1939. We discuss the project of an extremely minimalist villa in Gdynia designed by Bohdan Lachert and Józef Szanajca (1926), Barbara and Stanisław Brukalski house at Niegołowski Street in Warsaw (1928), considered the first implementation of avant-garde architecture in Poland, the sanatorium house in Konstancin (Skolimów) by Helena and Szymon Syrkus (1930-1931) or the housing estate of the Warsaw Housing Cooperative. The aim of the analyses is to define innovative solutions: more functional, efficient and human-friendly, spatial and technical innovations, in the scale of the building, housing estate and a wider urban and social environment.

1. Introduction
At the beginning of the 20th century, the traditional craft thinking turned into the scientific interpretation of spatial activities, which stimulated interest in novelty. The innovation was understood as in humanistic disciplines - the ability to discover and test the solutions which deviate from the
standard and which induce a rapid change in quality. Innovations of this period took the form of abstract and realistic ideas, methods based on alternative sets of criteria and technologies. They concerned the urban and architectural scale as well as the detail. In the particularly demanding living environment design, they manifested themselves in many objectively new values, such as functionalism, social housing, extensive typology of dwelling layouts, innovative reinforced concrete constructions of open plans, new standards of insolation, ventilation and many others. The paper presents analyses regarding modern thoughts about living, reflected in selected projects and realizations of the professors of Faculty of Architecture Warsaw University of Technology, 1918-1939.

2. Modernity. Novelty. Innovation

Innovation is an indispensable notion and at the same time a serious problem, in many different disciplines, not described in an orderly and versatile way. On the one hand, it is nothing new, it is one of the first ideas, disturbing and stimulating the consciousness of humanity. On the other hand, by definition - as something new, it seems to emerge from non-existence every time.

A breakthrough event influencing the perception of the new was Charles Darwin's theory of evolution, which tried to reconcile different ways of explaining the natural change. It presented the concept of a cycle in which form results from an inherited function, defined as suitability for specific environments [1]. Darwin introduced into the considerations a time factor that allows functional distinctions to create and change the form when it meets different functional needs.

Contemporary trends in European philosophy, especially those derived from the works of Gilles Deleuze and Alain Badiou, try to explain how the world generates true novelty. Whitehead and Deleuze placed creativity, innovation and novelty in the centre of metaphysical speculation. Appreciating the importance of change and the emergence of a new is a relatively new concept.

In 1962 Thomas Kuhn published “The structure of scientific revolutions” [2], which became a spectacular and influential expression of the new philosophy of science. At the same time, Norbert Wiener wrote “The Invention” [3], which can be treated both as an illustration of the Kuhn’s theory, as well as a premise creating a new context within the meaning of the concept of innovation. Kuhn created his book in the hope of changing the way of understanding science, thinking of it as a basis for understanding, close to nature. He believed that the scientific achievements treated so far as complements to knowledge were in fact revolutions that changed the basic nature of academic research. In this approach, scientific progress became more rapid and unexpected, and “The structure of scientific revolutions” was shaped by the modern twentieth century model of innovation. Although the author's attention focused on scientists studying the physical world, he referred to important contemporary achievements, such as non-Euclidean geometry, Albert Einstein's theory of relativity, and the uncertainty principle of Werner Heisenberg. Their common feature was the interest in relation to space and time, in which they referred to the very essence of objectivity.

Kuhn built his concept on the notion of a paradigm, the definition of which has changed over the years under the influence of his considerations. Referring directly to Ludwig Wittgenstein, he described the paradigm as a set of rules that is traditionally used practice. At the end of his life, he understood it in linguistic terms, as a lexicon, a universally accepted symbol system that the scientists studied to communicate. Regardless of whether it was defined in perceptual, psychological, sociological or linguistic terms, the paradigm was a perspective, a way of looking at the world that was becoming a world in itself.

Norbert Wiener was looking for a way to describe, as faithfully as possible, changes in real time and space, a continuous novelty in which the future is only partially determined by the past.
Mathematical and technological research related to the novelty of phenomena cast a different light on the situation in which the usefulness of the concept influences the directness of perception, and the new is always subordinated to the old. Wiener considered the information theory as the basis for more general scientific efforts, which he called "cybernetics" and considered the second industrial revolution. He was also interested in the innovation of scientific methodology. He wanted science to be a model of natural processes, powered by creativity deriving from randomness, but controlled in the development process and directed by continuous modulation. Cybernetics created volatility by recombining normalized components, as in the alphabet, where a random element is always present. It also relied on repeatability, which was recursive when the random element was returned to the system. Combining recurrence and recombination in this way, Wiener summarized Darwin's theory of evolution and developed a new model of innovation, combining the elements of the old. He saw the development of new ideas in four stages:

- intellectual stage, when a new idea arises in the mind of a person or (less frequently) a group;
- technical phase, in which it is necessary to use appropriate techniques or materials;
- social stage, when cooperation and agreement are established between intellectual and technical employees;
- economic stage, generating a method of financing and promoting the invention, when it turns out to be feasible.

The importance of innovation in art, science and everyday life is a topic considered by philosophers, art critics and scholars. Harold Rosenberg says that active painters, designers, architects and fashion people are spreading the belief in the domination of uniqueness [4]. The only thing that counts in contemporary art is, in his opinion, the fact that the work will be new. If the views we present refer to the field of shaping space, we must determine what criteria of uniqueness are particularly important for architecture. In the classic text on business innovation, Everett Rogers defines innovation as an idea, practice or object that is perceived as new by an individual or group [5]. There are many factors in the art of shaping space that strengthen the sense of rooting, which can stop the development of new ideas. The paradigm is based on the recognition of the role of the laws of physics shaping the foundations of construction, on the use of ergonomic references and finally on the correlation of new objects with the old within the spatial complexes of a significant scale. The formation of further elements of the built environment is easier to explain by recombining, processing, and explaining the structure than by searching for unique solutions that deviate from the standard.

The beginning of the 20th century was related to the transition from craft to the scientific interpretation of spatial activities, which stimulated interest in innovation. They were understood in a way close to natural and humanistic disciplines - like the ability to discover and test solutions that deviate from the standard, bringing about a rapid change in quality. Innovations of this period took the form of abstract and realistic ideas, methods based on alternative sets of criteria and technologies. They concerned the urban and architectural context and the scale of detail. In the particularly demanding design of the living environment, they yielded many new notions and objectively new values, such as functionalism, social housing, extensive typology of residential systems, innovative reinforced concrete constructions of open plans, standards of insolation, ventilation and many others.

3. Masters and teachers
The Faculty of Architecture of the Warsaw University of Technology was established in the first twenty years of the 20th century, when in traditional architecture and art European traditional trends were intertwined with new currents, which set the direction of building creativity. In 1915, the Society for Higher Science Courses and the Association of Technicians took steps to create a Polish university and polytechnic in Warsaw [6]. Finally, a separate architectural faculty was established at the newly created technical university. The members of the Organizing Committee and future professors
represented the diversity of the then architectural environment, both thanks to education in various European schools (polytechnics, military schools and art academies), as well as different aesthetic interests. This diversity was fully reflected in the architectural creativity of that period.

A breakthrough in the development of modern architecture in Poland was the formation of the Blok group [7], the avant-garde artistic initiative of the Cubists, Suprematists and Constructivists. Szymon Syrkus, Mieczysław Szczuka and Teresa Żarnowerówna joined it in 1925 and designed several layouts of apartments, buildings and complexes, exhibited at the First International Exhibition of Modern Architecture in Warsaw's Zachęta in 1926 [8]. After the split of the Block, in 1926, on the initiative of Syrkus and Bohdan Lachert, Praesens group was established. It brought together architects, painters and sculptors, among others Barbara and Stanisław Brukalski, Katarzyna Kobro-Strzemieńska, Bohdan Lachert, Andrzej Pronaszko, Henryk Starzewski and Józef Szanajca. Like Block, Praesens represented the Polish avant-garde that promoted functionalism, derived, among others, from the experience of Le Corbusier, Jacobus Johannes Oud and the implementation of housing in Europe and the USA. The group's aim was to create and propagate architecture that meets the widest social needs, using the possibilities of industrial production, based on the latest technical achievements. Architects and painters were discussing the shape and function of 20th-century architecture. In specific realizations, they tried to apply the principle of a comprehensive organization of spatial form and colour. They assumed that the designed buildings would be functional and rational in terms of technology as well as socially justified.

The Faculty of Architecture of the Warsaw University of Technology has become one of the most important centres for the development of modern architecture. Practising architects conducted classes in architectural design, strengthening awareness of new trends in housing design. Among them were Bohdan Lachert, Józef Szanajca, Barbara and Stanisław Brukalscy, Helena and Szymon Syrkus, Bruno Zborowski, Jan Chmielewski, Juliusz Żakowski and Juliusz Żórawski.

3.1. Villa in Gdynia
Bohdan Lachert, Józef Szanajca, 1926, figure 1.

Figure 1. Model of the villa in Gdynia designed by Bohdan Lachert and Józef Szanajca
The unrealized project of a minimalist villa inspired by ship stylistics and the solutions used by Le Corbusier in the Cité Frugès estate in Pessac was created around 1926, commissioned by Kazimiera Scheunertowa from Gdynia. A simple block made of intersecting cuboids distinguished the motif of external light stairs leading from the first floor to the roof. The program included a daily area on the ground floor, consisting of a living room with a spacious dining room, a kitchen with pantry, maid's room and toilets. On the first floor, the architects designed four bedrooms, designed for a maximum of seven people, a bathroom and a toilet. The optimized spatial layout provided the opportunity to implement all home functions, divided into a public and private zone designated by the division into storeys. The whole had a usable area not exceeding 120 m². The rational arrangement has reflected the innovative approach to the organization of space and the pursuit of a minimalistic, economical form corresponding to the function [9].

3.2. Brukalscy, own house
Barbara and Stanisław Brukalski, 1927-1928

The villa in Warsaw's Żoliborz district, at Niegolewskiego Street, was completed in the years 1927-1928. It is one of the earliest and most innovative examples of a single-family home solution in a form that differs from the then-popular manor architecture in Poland. The three-storey building housed a full program of a private residential home enriched with a studio. On the ground floor, there was a garage, hall, kitchen and dining room connected by a spiral staircase with a mezzanine of the first floor, intended for a workshop, next to a bedroom complex at higher levels. The location and internal layout of the kitchen and bathroom were designed with particular care. A well-thought-out functional layout of the plan was based on a centrally located staircase, which led to the roof garden terrace. Architects treated the interior as undivided open space and the composition of building elements was related to greenery, creating integrity with a garden. The expression of architecture shows clear influences of the neoplastic direction represented in Europe by Gerrit Rietveld. In the Brukalskis' villa, you can find analogies with the house in Utrecht - for example in the fragment of the facade from Niegolewski Street.

3.3. A sanatorium house on Królewska Góra in Skolimów
Helena and Szymon Syrkus, 1930-1931, figure 2.
A small holiday house was located on a rectangular plot near Konstancin, between the road from the north and the pine forest from the south. The rooms for the residents were designed as equal, equipped with running hot and cold water, central heating, built-in wardrobe, mobile beds raised for the day and standardized furnishing. The south-facing terrace opened to the south. Architects wanted the best possible insolation of the residential area, so the southern wall was equipped with large windows with awnings. They used an optimized steel frame structure, built with brick and finished with a Pińczów stone cladding integrated with light concrete, according to the patent of engineer Czesław Pukiński. Helena and Szymon Syrkus have conducted extensive studies in the field of housing. Analyzes of needs, program and functionality were initially used in single-family houses. An important direction of the work was the experimental solutions of the frame structure filled with a two-layer wall, applied at the house in Skolimów, developed in cooperation with the structural engineer Stanisław Hempel [10].

3.4. A residential building at Aleja Przyjaćół in Warsaw
Juliusz Żórawski, 1936-1937

The building, designed as an apartment house for the Ciechanów sugar plant, is still an excellent example of avant-garde housing architecture. The applied frame construction allowed for the implementation of Le Corbusier's Five Points of a New Architecture. Above the light, overexposed ground floor supported by pillars, there were five glazed storeys housing one- and three-room comfortable apartments equipped with elevators entering directly into the inner hallway. A characteristically curved roof, located not parallel to the façade concealing the elevator engine room, hung over the roof of the last storey. The elevations were covered with Szydłowiecki sandstone. The ground floor - with a rounded wall leading deep into the glazed representative hall - was originally finished with natural pebbles. An interesting solution enriching the drawing of the facade were the sunshades covering the glass portes fenêtre on the southeastern wall.
3.5. Cooperative dwelling, housing estate WSM in Żoliborz
Bruno Zborowski, Jan Chmielewski, Juliusz Żakowski, Stanisław and Barbara Brukalscy, 1925-1939, figure 3.

Figure 3. Cooperative housing estate WSM designed by Bruno Zborowski, Jan Chmielewski, Juliusz Żakowski, Stanisław and Barbara Brukalscy

The Warsaw Housing Cooperative (WSM) cooperated with avant-garde architects associated with the Praesens group, whose priorities of breaking with traditional forms and propagating standardization in construction were part of the program of providing cheap, comfortable housing for the average or low earners. The object of the Cooperative's activity, founded in 1922, was to meet the housing needs through the mass construction of small apartments, providing good living conditions and modern solutions with the lowest possible level of rent. In the 1920s and 1930s, it completed two modern housing estates: in Żoliborz and Rakowiec. The first consisted of nine residential colonies and service buildings, with a central heating boiler room, a laundry, a swimming pool and a theatre and cinema room. The housing estate on Rakowiec included seven houses with 293 units and 437 chambers for about 1070 inhabitants. WSM was looking for modern solutions, experimenting with different layouts and types of building.

In 1938, the housing estate in Żoliborz offered 1381 apartments and 2,697 rooms in twenty-one multi-family buildings. The majority were 1- and 1.5-room apartments (44.5%, 614 units). 2- and 2.5-room apartments were 38% (530 units), 3-rooms and larger - 17% (237 units). Most of the apartments had service part with a kitchen, sink, pantry or pantry cabinet, separated and placed in a niche. A curtain or a light wall with a door separated it from the room. In some three-room units, architects designed a so-called residential kitchen, which did not have a separate service part. All apartments were centrally heated, sewed, equipped with gas and electricity.

Colonies I-III and V-VI were created according to the design of Bruno Zborowski, colony VIII was designed by Jan Chmielewski and Juliusz Żakowski, and colonies IV, VII and IX by Stanisław and Barbara Brukalscy. The sixth colony included 4 service buildings that housed a central boiler room, a laundry room, a swimming pool, a theatre and a concert hall, a greenhouse and a kindergarten [11].
The search for innovative solutions included a set of issues related to shaping a modern, reasonably designed flat and accompanying spaces, as well as forming social estates. The improvement of the smallest dwellings project was based on the residents’ circulation analysis, concerning the relocation possibilities and units selection, and then through consultations with users who cooperated in the changes of the apartment plans. This was done using surveys or in the form of meetings during which architects discussed projects. Apartments in the cooperative were presented during CIAM congresses. The Frankfurt exhibition concerning the smallest apartment, where examples from Żoliborz were placed, was presented in WSM. Barbara Brukalska conducted studies on the organization of the household and the optimization of the kitchen layout, transferring the experience of Margaret Schütte-Lihotzky to Poland.

4. Conclusions
In the era of discussion on the future of architecture, between the second and third congresses of the CIAM, Sigfried Giedion outlined the postulates which could be considered as a modern housing program, interpreted in subsequent projects, realizations and in theory. He wrote about the need to free from:

- the house with eternal value
- the house with expensive rent
- the house with thick walls
- the house as a monument
- the house with high costs to enslave us
- the house that exploits women as cheap labour.

He believed that existing schemes must be replaced by:

- the cheap house
- the open house
- the house that makes our life easier

Characteristics of the innovative home of the new era were identified by Giedion with the postulate of achieving the value of beauty [12]:

- beautiful is the house that suits our lifestyle, which requires: lightness, air, movement, opening;
- beautiful is the house which adapts to the terrain conditions
- beautiful is the house which allows you to live in the mountains under the sky and between the crowns of trees
- beautiful is the house which gives light (walls of windows) instead of a shadow (walls with windows)
- beautiful is the house the rooms of which do not give a feeling of being in a closure
- beautiful is the house, the charm of which consists in combining well-designed functions.

The deterministic methodology of modernism was based on the necessity of a precise description of conditions, which was the starting point for seeking an adequate solution. Establishing a representative profile of a workers’ or clerks’ family was a condition for formulating an answer to the task posed by municipal housing companies. The settlements designed in this way made it possible to use a relatively comfortable flat for large and multi-generational families. The standard of equipment and sanitary devices suited the needs and in relation to the existing conditions, there was a significant improvement. The modernist model is difficult to call flexible unless we understand the flexibility as a predetermined ability to adapt. The actual use scenarios proved to be much more diverse than those established by architects.
Housing models of the modernism era were characterized by:

- innovativeness of utility and spatial layouts,
- grounds of functional solutions based on scientifically verified regularities (experimentally, analytically),
- unambiguosity, which preferred the expert competences of designers over getting to know the opinions and feelings of users,
- stability, which was justified by a strong intellectual foundation and the importance of social consequences,
- intended repetition and technology based on industrial methods of production of elements.

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