Affordable single-family housing. From the traditions of the Warsaw School of Architecture

Piotr Trebacz

Faculty of Architecture Warsaw University of Technology, ul. Koszykowa 55, 00-659 Warszawa, Poland
pt@ati.waw.pl

Abstract. The hundredth anniversary of Poland regaining its independence (as well as the 100th anniversary of the Faculty of Architecture of the Warsaw University of Technology) is an opportunity to reflect on the achievements of Warsaw’s architects. Designing a home which would be affordable to the Polish city citizens was an important for the Warsaw architects in the 20th century. The initial assumptions took into consideration the changing design requirements set before the architects (e.g. social, economic, or ecological). Thus the ideas and the creative designs that matched the current needs of the citizens of Warsaw, including the initiatives guaranteeing the availability of cheap, proprietary houses, are worth a closer look. In different periods of the 20th century, the idea of an affordable home found support in the urban planning: either in the form of a house in a garden city or a garden district, or by the support of economic, and at the same time ecological, construction. The architectural ideas were accompanied by the desire to ensure contemporary living standards, current aesthetic trends or the more popular stylistic trends. The modernist avant-garde of the "Warsaw school", its eminent theorists, practicing academics and students had a huge impact on the architecture of the capital as well as the whole Poland. The architecture and urban planning of Żoliborz in the 1930s is an excellent example. The works of young enthusiasts of the European modernism were preceded by the “Blok” magazine and the Praesens group (1926) connected with the CIAM. In the post-war period, practically the only choice for residents of Warsaw was a flat in a prefabricated residential block. The cooperative and private middle-class houses began to appear at the end of the 20th century. The single-family houses, representing the modest means of their investors, were represented and popularized by the Warsaw magazine “Murator” and its nationwide competitions "Affordable Houses”. The suburban landscape of today’s Warsaw is dominated by catalogue projects of different quality while the outskirts of the city comprise mostly very intensive residential developments commissioned by developers. They are mostly based on the “wild” urban planning, without any social program. The Warsaw's 1930s modernist style is continued today and is associated with good, logical and safe architecture, especially when compared with the hard to define the mass of the contemporary single-family houses. We long for the prestige and position of the avant-garde architecture which prevailed in the pre-war Warsaw. Neomodernism returns in the contemporary projects of the governmental program "Apartment Plus" and “Home Plus” (2018) which aims to create up to a thousand cheap, small, prefabricated houses. From hundreds of the competition submissions, the houses designed by the architects and students from our Faculty were selected to be built. The overview of the past century’s achievements of the Polish architects confirmed the thesis and initial assumptions. The results of the exploration have been used in design practice: i.a. in the affordable home competition project, which was highly regarded both by the public and the jury (first prize).
1.  Introduction: in the circle of tradition. Warsaw School of Architecture

Poland regained its independence in 1918 and it influenced the migration of people to Warsaw. In the capital, rebuilt after the partitions and World War I, the employees of the new factories, offices and administration needed affordable, small houses and modern apartments which could be built fast. Within a few years, the new districts were brimming with architecture which could compete with the best European projects of that time. The high demand for housing was met by rational single-family housing designs.

The 100th anniversary of the Faculty of Architecture of the Warsaw University of Technology (1915-2015) was an opportunity to reflect on the "Warsaw school of architecture" and the work of its graduates. The ideas and designs that matched the current needs of the citizens of Warsaw, including the initiatives guaranteeing the availability of cheap, own houses, are worth a closer look.

But where did the strength and character of the "Warsaw school" come from? - its first professors were practicing professionals educated at the best universities of the then eastern and central Europe: in St. Petersburg, Moscow, Riga, Dresden or Darmstadt [1]. They came to the capital of Poland, which did not exist for 123 years, to create a new, Polish school of architecture. A school which would break with the tradition of Russian classicism or with the eclectic architecture of old Europe.

In the years of the partitions, the generation of Poles of the late nineteenth century was brought up in the spirit of the positivist idea of "organic work" and "work at the grass roots" [2]. Professors, representatives of this generation, demanded organic, tedious and everyday work from their students. Such upbringing shaped the attitudes of the young architects of the Reborn Poland; engineers, who were not alien to the new social ideas. The school emphasized the broadest possible, comprehensive education, which integrated technical disciplines: civil engineering and building services with architecture and artistic subjects. It enhanced them with the knowledge of the history of architecture, art and civilization. Engineers were educated in mathematics, the strength of materials, costing, and at the same time, in art - in the characteristic "Warsaw school of drawing" [1]. This balance between technology and art as defined by Stanisław Noakowski still remains the basis of the idea and educational mission of polytechnic architecture, which is shown in the name of the degree on the diploma: "master engineer architect".

2.  Modernist avant-garde

The outstanding practitioners, professors of WAPW and their students, comprised the modernist avant-garde of the "Warsaw school", which had a huge impact on the architecture of the capital and Poland. The first graduates of the capital’s school already in the 1920s started to implement new ideas and innovative projects. The best example is the architecture and urban planning of Żoliborz – a Warsaw district designed in 1920-25 and built mainly in the 1930s. The works of young enthusiasts of the European modernism (Szymon and Helena Syrkus, Stanisław and Barbara Brukalski (Figure 1), Józef Szanajca and Bohdan Lachert), were preceded and supported by the magazine "Blok" (1924-26), as well as the progressive artistic group Praesens (1926), related to CIAM [3]. The young architects established their own Association of Polish Architects and began to achieve their first successes with their cheap housing estates commissioned by various Warsaw institutions. This was the time when huge urban areas were developed, such as TOR (Towarzystwo Osiedli Robotniczych), WSM (Warszawska Spółdzielnia Mieszkaniowa) and the Stowarzyszenie Budowy Mieszkań ZUS.
2.1 Social issues over aesthetics

Ideas for modern housing estates and houses in different periods of the twentieth century were supported by urban planning concepts: either in the form of a house in a garden city or a garden district (in the interwar period, for example, the project "Garden City Czerniaków" or "Garden City Ząbki"), or by supporting economic and ecological construction (e.g. in the suburban individual and cooperative housing). The integration of urban planning and architecture is characteristic of the "Warsaw school". It's clearly visible in the coherent design of the WSM Żoliborz. The greenery and the landscape were considered equally important to architecture and urban planning.

Architects of the young generation were actively involved in the work of progressive organizations building cheap apartments and "affordable homes" for the less affluent residents of the new districts of Warsaw. They well understood the limitations and imperfections of the design and construction of housing complexes commissioned by private capital. They saw a chance in the social and cooperative construction [4].

The social architectural ideas were accompanied by the desire to provide contemporary civilization standards. New apartments and houses were equipped with modern kitchens, bathrooms and connected to municipal media. This was accompanied by a concern for the aesthetic realm of the designed objects, expressed in the desire to follow contemporary trends, breaking with the stylistic trends in the country, including national historicism (e.g. "manor house style" of the Staszic colony in Warsaw).

The main goal was to "seek new solutions [technical and functional] rather than forms of architecture". The curriculum of young architects has departed from "composition" to "the skill of purposeful and economical design as the essence of the architect's work" (W. Krassowski). Lech Niemojewski - the last dean of the faculty in the interwar period, clearly formulated that the Warsaw school "became the core of the movement, which among the architectural problems put the social issues over the aesthetic ones" [5]. To describe these phenomena, attitudes and trends, contemporary architecture theorists often use the term "Warsaw’s neopositivism" (A. Dybczyńska-Bułyszko) [2].

Functionalism and social thinking, as well as great, comprehensive education and individuality of the young artists, have taken Warsaw's interwar residential architecture to the European level. This success and quality have not been achieved by successive post-war decades.

Figure 1. House for the “Tani Dom Własny” [TN - “Own Cheap Home”] exhibition, Warsaw, Bielany, 1932, designed by B. Lachert, J. Szanajca [6]

2.2 "Wisely poor" own home

New forms of single-family housing and construction technology were widely sought after. However, it was a rational economy, in which the main goal was not to lower the standard of buildings. This
rationalism has been manifested in many areas, both urban, functional and technical. Small, cheap but quality houses had good, functional and simple layouts, economic construction and minimalist detail. Their authors were not alien to the latest construction technologies, such as frame construction with elements of prefabrication. Young architects understood the needs of the moderately wealthy recipients of their architecture and responded to the needs of society. Konrad Kucza-Kuczyński described this architecture as "wisely poor".

Leading young architects: Romuald Gutt, Bohdan Lachert, Józef Szanajca took part in the competition for a "cheap home" (1932), which resulted in the construction of prototypes of the model homes as part of the exhibition of the Polskie Towarzystwo Reformy Mieszkaniamiowej [TN - Polish Society for Residential Reform] in Warsaw Bielany [7]. Two of those students had the same thesis supervisor (Prof. Rudolf Świerczyński), and they have chosen a single family house as the subject of their diploma. In the "cheap home" competition, the audience chose a minimalist house with wooden cladding, made according to the designs of W. Miller, which also confirms the maturity of the choice, which could be difficult today (Figure 2).

![Figure 2. House for the BGK exhibition, Warsaw, Kolo, 1935, designed by H. and S. Brukalski [8]](image)

3. **Houses of the end of the century, half a century lost (1939-89)**

In the post-war period, virtually the only choice for Varsovians was a flat in a prefabricated block. The cooperative and private middle-class houses began to appear at the end of the 20th century. The few successful cooperative projects include Piechotka’s [9] housing estate in Żoliborz and Ursynów and Jerzy Kumorowski’s housing estate in Saska Kępa (1982) [10].

Logical, functional single-family architecture, corresponding to the modest possibilities of its investors, was popularized by the Warsaw magazine "Murator" [11] and its nationwide competitions “Domy Dostępne” [TN - "Affordable Houses"]. In the absence of the support from the government, it was difficult to introduce good, economical model single-family architecture. It is worth mentioning that the pre-war modernist avant-garde fought against national historicism more effectively also thanks to the support of governmental lending, preferring modern architecture. Catalogue projects of different quality dominate the suburban areas of Warsaw. The outskirts of the city consist mostly of very intensive residential developments commissioned by the developers. They are mostly based on "wild" urban planning, without any social program.

Similarly to the interwar period, at the end of the 20th century, the parallel trend in architecture is neovernacularism, visible in some single-family house designs. The achievements of the “Warsaw school” at the end of the twentieth century are significant, as evidenced by the victory in the „La casa
più bella del mondo” competition and the construction of the house by the architects from our school (Piotr Szaroszyk, Janusz Kaczorek, 1989) (Figure 3).

Figure 3. House designed by P. Szaroszyk, J. Kaczorek, 1989, 1st place in the “La casa più bella del mondo” competition, built in Reggio nell’Emilia, Italy [12]

4. Return to modernism
Nowadays the 1930s Warsaw's modernist style is experiencing a renaissance. The style is continued today and is associated with good, logical and safe architecture, especially when compared with the hard to define mass of the contemporary single-family houses. We long for the prestige and position of the avant-garde architecture which prevailed in the pre-war Warsaw and did not appear as intensively anywhere else in Europe.

The idea of "Mieszkanie Najmniejsze" (TN - "Smallest Apartment") (1930) or "Tani Dom Własny" (Figure 1) (TN - “Own Cheap Home”) from the exhibition of the Polskie Towarzystwo Reformy Mieszkaniowej (1932) was recalled after almost 90 years in the state program, when negligence in the field of social housing construction is huge and impossible to catch up within several years. The wild residential developments of the last quarter of a century, whose only goal was to maximize profits and construction intensity, contributed to a significant reduction in the quality and perception of the needs of recipients of Polish housing architecture. We can only dream about the possibilities of implementation and support from government programs that the first creators of the "Warsaw school of architecture" had a hundred years ago.

Cubistic forms of prefabricated single-family houses easily multiplied in thousands by the construction industry pose a threat to mass architecture, making it inhumane. A certain danger of returning to the systemic, unified architecture of industrialized housing construction requires increased vigilance from architects. The inept repetition of the "seeming simplicity" of masterpieces of the modernist avant-garde, without understanding the reasons for the simplifications, many times in history ended in failure, not only in Poland.
5. Thinking about today and tomorrow. Apartment Plus program

Neomodernism returns today in the contemporary projects of the government program of building up to a thousand cheap, small, prefabricated houses from the "Home Plus" competition (Figure 4). From hundreds of the competition submissions, the houses designed by the architects and students from our Faculty were selected to be built. Their authors, not only because of their architectural pedigree, have a license to feel as the continuators of the "Warsaw school".

Figure 4. Model single-family housing, designed by P. Trębacz, J. Pieńkowski, D. Ryżko, W. Gago, 2018 [TN - “Home Plus”] first prize in competition “Dom plus” [13]

Figure 5. Terraced house, 2018, P. Trębacz, J. Pieńkowski, D. Ryżko, W. Gago, 70 m2, 6.1 x 7.6 m [14]
Figure 6. Semi-detached house, 2018, P. Trębacz, J. Pieńkowski, D. Ryżko, W. Gago, 70 m², 5.8 x 8m [15]

Figure 7. Detached house, 2018, P. Trębacz, J. Pieńkowski, D. Ryżko, W. Gago, 80 m², 7.4 x 7.4m [16]
The subject of the competition was the design of model single-family houses for a family with three children, intended for construction in smaller agglomerations and areas dominated by single-family housing. System houses were to be designed in four variants: as a terraced (Figure 5), semi-detached (Figure 6), detached (Figure 7) and country houses (Figure 8). The biggest challenge turned out to be the creation of a modern, functional home for a family of 5 with an area limited to 70 m2. Only the detached houses could have a slightly larger area (10 m2 more). The goal was to find a rational, intelligent and economical as well as durable solutions to minimize the time of construction. Houses for rent were to facilitate the migration of young families following the rapidly changing labor market. They were also supposed to have flexible internal spaces that could be easily adapted to the changing needs. The construction program of hundreds of thousands of rental apartments and houses was to be the driving force of the Polish economy and demographic growth.

Thus formulated assumptions of the Mieszkanie Plus program ideally fit into the traditions of the "Warsaw school of architecture", based on rational design, functional architecture, while enjoying the latest technological achievements. The very idea of creating green settlements with a social program was also attractive, allowing the architect's mission to be realized, as with the "positivists" from the first years of the Warsaw school. Such beautifully formulated requirements made it possible to forget about politics and were a springboard for the developers after 25 years of work pursuing other goals.

The following assumptions form the basis of the project:

**Functional houses:** with a very simple interior layout and a minimal circulation, the "family table" in the centre of the house (Figure 9); without interior structural walls, houses can adapt to changes and can be rearranged; they can adapt to different families and changing needs of their residents; they are convenient and accessible to a disabled person after making small internal changes. In the basic variant, the optimal arrangement for the 2 + 3 family was shown on the plans.
**Figure 9.** “Family table” in the centre of the detached, 80 m² country “Home Plus”, designed on the plan of a cross cross plan, with four bedrooms in corners, 2018, P. Trębacz, J. Pienkowski, D. Ryżko, W. Gago [18]

**Economy houses:** very simple and fast to build houses; with "industrialization" of the production of modular wall elements, it is possible to build the house in 4-6 weeks; compact and built on a rectangular plan; with cheap and warm walls; durable houses "for today and tomorrow", enabling the construction of a cheaper, basic version, permitting gradual retrofitting with further solar collectors or blinds and shutters; with a rational limitation of the total construction and operation costs while supported by the right Polish and EU policies.

**Energy-efficient houses:** with very good thermal parameters of walls, using modern technologies that reduce energy consumption for lighting and ventilation.

**Ecological houses:** built from materials that are easy to recycle: from heavy protein based foamed concrete and thermal insulation from wood-based materials, hemp or lightweight foam concrete (as a replacement for polystyrene foam); houses using simple and affordable solutions, with low energy cost of production; houses with architecture coexisting with the natural surroundings; immersed in greenery, with a small water reservoir improving the climate and lighting of rooms in the countryside version; energetically autonomous (as an option), almost "zero energy", thanks to the use of the dual-purpose solar collectors and a ground heat storage under the house; the solar energy will be stored for the winter and partly converted to electricity; houses using rainwater through a combined sewer system with the separation of gray and black sewage, in the countryside version with its own sewage treatment plant, a composter, a recycling bin for waste segregation and a waste squeezer.
5.1 Modularity of structure and industrialization of the construction

In the proposed buildings it is possible to use interchangeable construction modules: 120/90/80/60/45/40/30 cm depending on the technology of production and transport of the elements (Figure 10). The prefabrication can be full or partial. To increase the speed of production we decided that the production should be industrialized: medium-sized wall elements, floor slabs, entire walls of building in their bare state, without windows; walls with windows and finishes, entire 2,70 x 3,65 m room modules. We also aimed for the reduction of time-consuming masonry finishing work on the construction site. Depending on the type of the house and location, several construction technologies have been proposed. This allows for the construction of a terraced house with the medium-sized precast reinforced concrete with foam concrete sandwich panels with prefabricated ceilings or CLT (cross laminated timber).

The house is built on a thin, reinforced concrete foundation slab, with embedded underfloor heating cables, insulated from the bottom with foam concrete or extruded polystyrene foam. As an alternative, entire external wooden walls can be prefabricated and transported with the windows already embedded. Depending on the location and the scale of the investment, it is possible to divide the prefabricated elements into smaller modules with the goal of installing the windows and finishing the construction on site. Light partition walls built after the flooring allows for a flexible interior arrangement. As an option, sliding walls allow to separate a bedroom from the living room and the children bedroom. In the most advanced version, the design assumes the prefabrication of entire room modules together with the floor and a roof in the light wooden construction.

It is also possible to make them in the thin-walled precast concrete technology with wall heating already installed. The dimensions of the modules are adapted for efficient transport (all four rooms have gross dimensions of 2.70x3.65 m, which makes it possible to transport them with a semi-trailer truck). The remaining elements of the building, including the ceiling and sections of the walls between the ready-made modules, will be made on-site in a timber frame construction, possibly with the help of the future residents. We assumed that the walls will be insulated on site and finished with exterior materials and cladding patterns characteristic of a given region of Poland. Regarding the utility systems the house will be equipped with a ventilation system with recuperation, and as an option: ground heat exchanger, rainwater tank. A recycle bin with waste segregation and a waste squeezer can be placed by the fence.

5.2 Participation of residents

We decided to give the residents the ability to participate in the production of the semi-finished products and in the building of the houses. Despite the prefabrication of a large portion of the elements it will be possible to replace the industrial part of the production with work of the residents on site. The participants will be able to prepare wall elements, assemble the partition walls (e.g. skeletal ones);
in the assembly of sanitary and electrical installations, furnishing, installation and finishing the bathrooms, laying the floors (e.g. floor panels).

![Figure 11. Model high density small residential quarter, (up to 100 terraced houses per 1 ha, min 70 m² lot per 1 house), 2018, P. Trębacz, J. Pieńkowski, D. Ryżko, W. Gago [19]](image)

5.3 Houses in the estate and on the plot
We have designed houses so as to enable the development of suburban and rural settlements. The model houses can be set in different orientations with respect to the parts of the world (Figure 11). The proposed models of terraced and semi-detached houses allow for more intensive developments on smaller plots and to create cheap home housing estates. The parking spaces were moved to the outskirts of the estate. In the project, we have established a gradation of space from the private through the semi-public, assigned to smaller and larger communities, up to the public. A housing estate needs places for integration of its residents so we have designed a small “town hall”, a small shed near the fire grill, a playground, a shared garden and a small park. The inhabitants will decide about the spaces between the houses and their use.

6. Conclusion
The proposed model houses are attempts to find a new way for a rational, "modest" architecture in the era of the mobile information society. Despite the passage of over one hundred years, the principles and goals of the "Warsaw school" have not changed significantly. They were subject to gradual evolution supported by a multithreaded analysis of the new issues concerning housing construction.

The awareness of today's designers has been enriched by the experiences and failures of the Polish architecture depending on the subsequent, changing political regimes. Poland's transformation and "freedom" after 1989 did not give such spectacular effects in the development of Warsaw architecture as the regaining of independence in 1918. New civilization achievements, economic and technical opportunities have not helped to reduce the distance of Polish architecture and construction to the rest of Europe. Perhaps the goals and principles have to be defined anew, quickly set the perspectives for the Polish construction: accessible, affordable and modern.
At the same time, we are trying to educate a new society in the field of wise management of space, protection and care for a friendly environment. We are slowly returning to "work at the grass roots", but no longer "at the foundations", because our heritage, building traditions have survived and have not been forgotten.

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