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Add, Transform, and Utilize. Possibilities of Applying Druot, Lacaton, and Vassal's Modernization Strategies and Solutions in Polish Large-Panel Housing Estates

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Abstract: In 2004, in response to France's 1960s and 1970s urban regeneration program proposing the demolition and redevelopment of large scale social housing developments, Frédérik Druot, Anne Lacaton, and Jean-Philippe Vassal created their PLUS theory (PLUS—Les grands ensembles de logements–Territoires d'exception). Its main aim was to modernize the existing buildings, and to add extra living space, functional freedom, and comfort. This essay examines the PLUS strategy and two of the architects' projects: the Bois le Prêtre Tower in Paris and the Grand Parc housing estate in Bordeaux. Its aim is to examine the tools used by the architects and investigate the purposefulness and potential of using their solutions in Polish large-scale prefabricated housing estates. Combining the categories of luxury and saving in redevelopment of housing estates paves the way for a new outlook. Maximizing living space, quality, and freedom of living in housing facilities that are not part of the commercial luxury segment of the housing market may prevent potential gentrification and homogenization of the social structure in individual city districts.

Keywords: large-scale prefabricated housing estates; modernization; circular design; the Bois Le Prêtre Tower; the Grand Parc estate

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1. Introduction

It is estimated that about 8 million people in Poland live in prefabricated buildings in large housing estates, i.e., over 20% of the population [1]. If only urban residents are taken into account, this percentage already accounts for 50% of the population [2]. Although, from time to time, sensational articles appear in the press questioning the viability of these structures, there are no technical reasons for their mass demolition. The Institute of Building Technology denies the common opinion that large-panel blocks were erected with an assumption of just a 50-year life cycle. As research shows, structures of inhabited buildings meet modern safety requirements and can be used for the next decades [3,4]. Approx. 40% of these buildings still require thermal modernization. The estimated cost of renovation works by the end of this decade is PLN 25.8 billion. After obtaining a technical report on this subject [5] in 2018, the Ministry of Investment and Development (now the Ministry of Regional Funds and Policies) decided to increase funding for the Thermomodernization and Renovation Fund and support renovations by allocating 16–21% of the budget to thermal modernization and 50% to the reinforcing of structures. Public subsidies can, therefore, amount to up to PLN 7 billion [6].

There is a high risk that the measures proposed by the Polish government will result in undertaking point-based, unplanned projects in a broader context, whereby non-systemic modernization works on large-panel housing estates. This may lead to an improvement in the functioning of these estates in one area of energy consumption, but the lack of improvement in the long term can cause a decrease in quality among other spheres (such as aesthetic or spatial) of the residential environment. The modernization and renovation works completed so far in post-war housing complexes in Poland show that attempts to develop a comprehensive vision of changes are rare. Investments in existing buildings

are usually ad hoc measures. Administrators only order projects limited to the selection of insulation material, façade colors, replacement of barriers on balconies, and canopies above entrances to staircases (Figure 1). The experience of West European countries, as well as Polish research, show that, in many cases, such strategy is not enough to create or maintain a sustainable housing environment [7,8]. Estate renewal is a type of conversion that Fabio Lepratto defines, after Christian de Portzamparc, as follows: "conversion is increasingly perceived as a creative challenge, an aesthetic as well as economic and ecological opportunity. Projects that interpret conversion in the most interesting ways demonstrate an aptitude for real re-thinking about uses, spaces and shapes; they don't just play at recovery, rehabilitation, energy efficiency, or cover-up; they don't just return the building to its initial state while improving its performance" [9].

Figure 1. Renovation of prefabricated post-war housing estate in Warsaw © Cezary Piwowarski [10].

It is difficult to find a Polish example of a comprehensive revitalization of a post-war housing estate going beyond thermomodernization and visual refreshment of buildings. The attempts undertaken by VROA studio to develop a comprehensive vision for modernization of the prefabricated housing estate designed by Jadwiga Grabowska-Hawrylak, situated at Grunwaldzki Square in Wrocław, were not reflected in the subsequent implementation [11]. Furthermore, this project concerned a unique housing estate in terms of architecture and urban planning, standing out among other complexes built using the prefabrication systems most popular in the period of the People's Republic of Poland.

In order to refer to foreign examples, it should be noted that not all theories and revitalization projects for West European large-panel housing estates can currently be implemented in the Polish context. Two main trends can be noted in the modernization and revitalization of housing estates. The first is comprehensive revitalizations, taking into account complete or partial demolitions, such as, for example, reducing the number of stories, diversifying the top of the building, or shortening it. This approach is proposed, for example, by Stefan Forster Architekten in Germany who have transformed a housing estate in Leinefelde [12] or, in Poland, by Barbara Gronostajska who has proposed theoretical revitalization projects for Wrocław housing estates [13]. The second path assumes activities that do not reduce buildings but interfere with the existing tissue through expansion or addition of superstructures or external spaces, transformation of façades and internal structure of buildings, and reorganization of their immediate surroundings. This trend includes the activities of offices such as the Dutch Vanschagen Architecten [14], NL architects [15], or French architects (Druot, Lacaton, and Vassal—i.e., the authors of the additive theory of revitalization "Plus") [16]. What distinguishes the latter in comparison with other designers

involved in the modernization of post-war prefabricated housing estates is the inclusion of their activities in a theoretical framework and the proposal of systemic solutions that can be applied in different ways, depending on the context of modernization activities. The limited number of prefabrication systems used in the Polish People's Republic and their modularity also allow creating systemic solutions on a large scale, as seen in Figure 2.

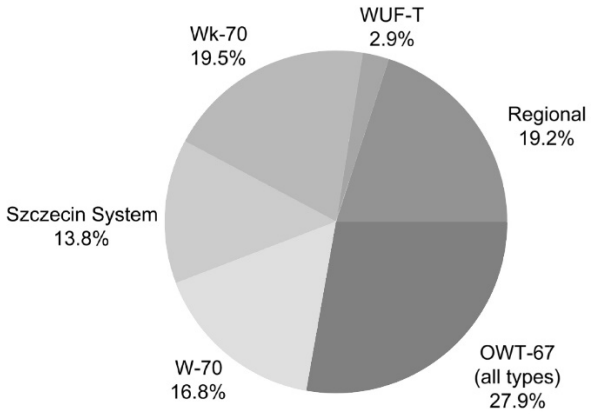

Figure 2. Percentage share of each prefabrication system in the usable area of panel buildings in period 1970–1985 in Poland. Source: drawing by the author based on [17].

French architects created the "Plus" manifesto to convince a broad audience, i.e., national and local authorities, property managers, residents, and users, to not use the seemingly simplest solutions. As mentioned before, Poland has a great need to change an attitude towards modernization strategies in large-panel housing estates. The language of the manifesto, systemic approach, and the multi-aspect nature of the study is, therefore, a suitable case for analysis. For this reason, and taking into account the shortage and complicated ownership structure of residential premises in Poland hindering revitalizations involving demolition and reduction in the number of apartments, it was decided to analyze both theoretical considerations and implemented modernization projects by Druot, Lacaton, and Vassal. After defining strategies used by architects and the ways of their implementation, the possibility of using them in Polish modernization projects will be examined. Such a list will allow to answer the question whether and what strategies and architectural solutions for the modernization of large housing estates can be exported from West Europe to Poland, an East European post-socialist country.

2. Materials and Methods

The research was carried out in two stages. Initially, the manifesto of the Druot, Lacaton, and Vassal, known as "Plus", was analyzed to define their basic principles and strategies. The "Plus" manifesto was conceived in 2004 in response to the nationwide revitalization program (Programme de Renovation) announced in 2003 by the Agence Nationale de Renovation Urbaine. One of the main assumptions of this program intended to remedy poorly functioning housing estates was to demolish existing facilities and build new ones [18]. The architects proposed another strategy in their manifesto, consisting of essays on the nature of manifestos; interviews with Druot, Lacaton, and Vassal (on ecology, mass production, luxury in living, standards, etc.); a catalog of possible transformations; and examples of implementations in the form of conceptual designs of modernization of large-panel housing estates [16].

In addition to the theoretical work of the architects, two implementations of their postulates were also analyzed: the Bois le Prêtre skyscraper in Paris and the Grand Parc building complex in Bordeaux (designed in collaboration with Christophe Hutin architects). The juxtaposition of these two projects allows, where necessary, an examination of the possibilities and effects of implementing the ideas of architects on two scales: a single building and a complex of three residential facilities, forming a part of a large housing

estate. Such a comparison is essential due to the point interventions strictly corresponding to the needs of residents and the costs of modernization. In this context, the scale of the intervention might have a significant meaning. There is also a third modernization project completed—La Chesnaie in Sant Nazaire, which verifies the French architects' theory. However, a large-scale extension of the building was introduced, which significantly changed its footprint and doubled the number of apartments. Such intervention must be explicitly analyzed with the context and possibilities of the plot of land, which is not the subject of this research. Taking that into account, the project in Saint Nazaire was not analyzed.

Looking at the postulates of the Druot, Lacaton, and Vassal team, and the way of implementing the theory in the residential building modernization projects, helped to define six key principles that could be possibly introduced to Polish revitalization projects:

1. Never demolish, always add;
2. Provide luxury;
3. Keep the existing community;
4. Give what the inhabitants need;
5. Plan;
6. Save.

The article was conceived as an analysis of the possibility of undertaking modernization activities in Poland on a larger scale, a contribution to the discussion and implementation of potential solutions. Therefore, when defining the key principles, a language referring to the nature of the "Plus" manifesto was introduced. The nature of these phrases goes beyond the expected standards of academic language but is part of the analysis of the activities of French architects. The way of communication of the proposed actions plays a significant role in its potential success.

These postulates were then analyzed in terms of the possibility of their implementation in the Polish legal, social, and economic context. The result of compiling this list is the verification of the possibility of implementing the strategies and design tools used by the French architects in the Polish context. The chosen method is aimed at examining the limits on the implementation of solutions used in West Europe in post-socialist Poland. The architectural and urban guidelines for building large housing complexes in the both regions were based on theories developed by the modernist community associated with CIAM (listed most extensively in the Athens Charter [19]) and the Bauhaus. The forms and functional and spatial solutions of buildings are similar, regardless of the place of their implementation, which was related to the modernist idea of building from scratch, without referring to the existing context. Their implementation and methods of populating and administering, however, differed significantly in the countries of the West and East. Therefore, a study on the adaptability of these French solutions also requires an analysis of the possibilities and legitimacy of importing and globalizing the applied ideas and architectural solutions in large housing estates.

3. *Plus*. An Additive Theory of Revitalization and Its Implementation

Never demolish, always add

"(. . .) It is a matter of never demolishing, subtracting, or replacing things, but of always adding, transforming, and utilizing them"[16] (p. 29) are the words of Frédérik Druot, Anne Lacaton, and Jean-Philippe Vassal, which explains how the manifesto began in 2004, initially as a firm response to the planned demolition of large-panel housing complexes by the national authorities. The architects proposed a new approach to the post-war development: preserve the existing buildings in their entirety with the communities inhabiting them, and act by adding and modifying the existing tissue. They found justification for their approach in three main aspects:

- ecology, understood as the reuse of the existing matter: recycling and use of natural processes to reduce energy consumption [16] (p. 65);

- preserving the existing communities by not relocating residents;
- savings, thanks to which funds are directed to activities that improve the comfort of living, and not to ineffective construction works [16] (p. 63).

Large post-war housing estates are better equipped and in better technical condition than multi-family tenement houses from the 18th or 19th century. Their insulation performance, both thermal and acoustic, is much better. In addition, good lighting of apartments with natural light and high efficiency in the use of space are characteristic for modernist housing construction. The ratio of the general communication area to the usable area is very low in apartments [16] (p. 31), which reduces the operating costs. Furthermore, the structure of the buildings allows easy demolition of the façade and its conversion or expansion. Next, the urban planning of housing estates and long distances between buildings provide space for expansion. In most prefabrication systems, the external walls are not structural but only curtain walls. It was not the urban layout itself or the structure of the buildings that prompted national and local authorities of France to decide to demolish, but social problems, bad reputation of large estates, and low prestige associated with living in such places. Therefore, the proposed solution in the form of demolishing buildings and building them anew was not matched to the source of the problem.

Druot, Lacaton, and Vassal proposed a conversion of buildings, specifically by enriching them with undeniable qualities, in terms of economic, environmental, and housing conditions. Among the tools that can help to achieve this, they suggest the following: enlarge the area of living rooms by 60–100% (so that they become a living space, and not another room); make façades more "transparent"; introduce balconies and terraces; eliminate problems related to mezzanines; de-densify ground floors (to introduce services and spaces that can be used only by residents); design inviting and safe halls; introduce new complementary housing; give specific functions to outdoor spaces; and supplement and densify the structure of estates (to create a sense of closeness and have services provided nearby) [16] (p. 31).

As the first project to meet the above guidelines, the architects modernized the 16-store Bois le Prêtre skyscraper in Paris in 2011 (built in 1962), which was initially condemned. They proposed a transformation of 100 residential units and common spaces [Figure 3]. They expanded the building on the northern and southern sides, adding 560 square meters to the accommodation space, and a 3-m-deep additional unheated space on the east and west, thus increasing the area of the building from 8900 to 12,900 square meters (by 45%) [20]. Two elevators were added, which were accessible from the level of apartment entrances, and the entrance lobbies were made flush with the ground level, and were opened and glazed.

The architects adopted a similar strategy for the first stage of revitalization of the Grand Parc housing estate in Bordeaux, where, instead of demolition, they proposed renovation of blocks G, H, and I, containing 530 housing units. They added 3.8-m-deep loggias in buildings H and I on the south (Figure 4) and in building G on the east and west. In addition, 8 new apartments were built in the form of a superstructure, which increased the total area of the buildings from 44,210 to 66,710 square meters (by more than 50%). One elevator was enlarged and glazed, and the second one was added. On the ground floor, the entrance halls were opened and enlarged, and bicycle and stroller rooms accessible from outside of the building were provided. Moreover, the apartments were modernized with renovated bathrooms and replaced wiring, and gravity ventilation was converted into a hybrid system [20].

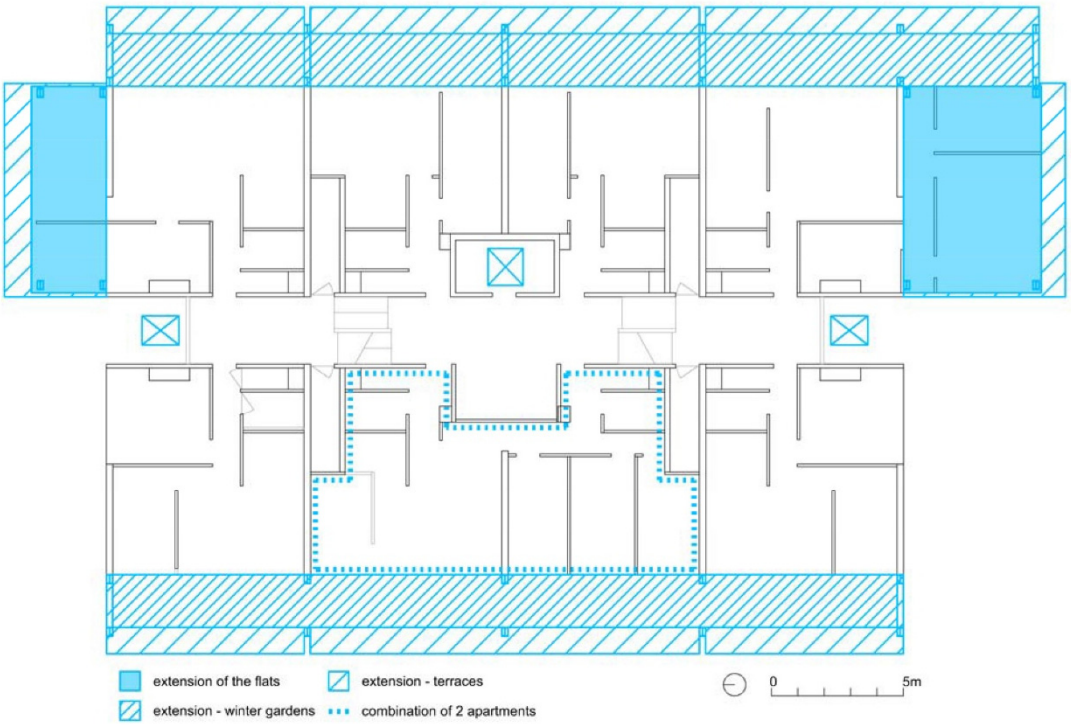

Figure 3. Transformation of the Tour Bois le Prêtre in Paris. Plan of the even level. Drawing by the author, based on [21].

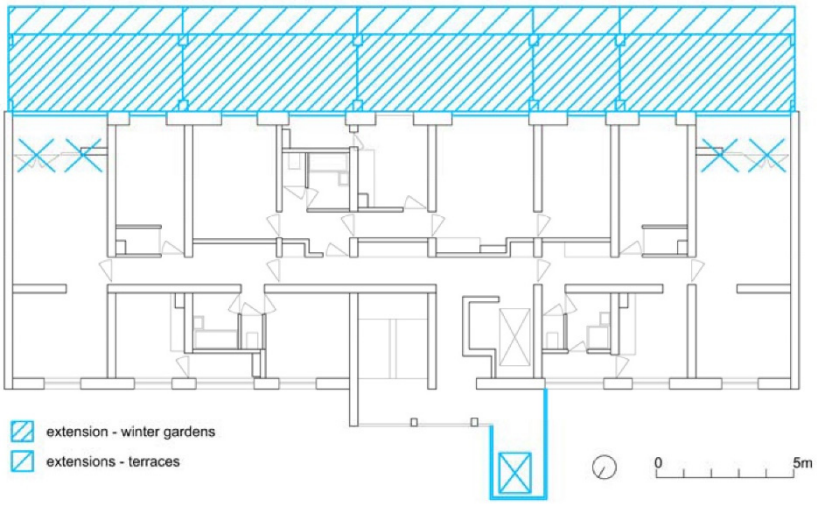

Figure 4. Plan of the part of the buildings H and I in Grand Parc estate after transformation. Drawing by the author, based on [21].

Provide luxury

Druot, Lacaton, and Vassal want to provide residents with luxury, which they define as "giving freedom, pleasure, generosity, well-being, and sky" [22] (p. 33). They assume that the conversion of social buildings should provide maximum living comfort, comparable to that found in luxury apartment buildings in elegant districts. The modernization of a building should be carried out with a view to the longest possible service life, durability of the materials used, and timeless functionality [16] (p. 31).

Their design method assumes thinking about the building from the inside of its apartments. They try to maximize the comfort of living in private spaces by dismantling the prefabricated façade; replacing it with sliding full-story high windows; and by adding concrete modules to the façade from winter gardens ranging from 2 m (Bois le Prêtre) to

2.8 m (Grand Parc), closed with polycarbonate panels and 1-m terraces. A border space is created between the interior and the outside, and between the shelter and opening to nature. Thanks to this, the living zone of residents increases by half and they gain access to light, fresh air, and a view. In opposition to the apartment area precisely programmed by modernists, this new zone is free of functions. The decision on how to develop it remains the responsibility of the residents. In addition, thanks to the entrances to the winter garden from all the rooms adjacent to the façade, the circulation in the apartment is much more free.

The completely glazed façade also visually gives an impression of luxury, and looks more spectacular and modern than many new investments, both public and commercial. This procedure significantly changes the urban landscape; from the monotonous "gray" uniform façades, glass façades emerge, shimmering in the light, reflecting the surroundings and the sky. The architects' openable façades and curtains give residents freedom to decide to what extent they want to interact with the outside world both visually and in access to natural light and air. The façades of the building, on the other hand, gain another variable parameter, thanks to which modular large walls become dynamic and unpredictable, depending on the actions of residents.

Preserve the existing community

Working on an existing and inhabited building raises problems that are unheard of in the construction of new residential complexes. One of the principles of "Plus" is the modernization of buildings, allowing residents to stay in their homes. Therefore, the architects do not assume any demolitions and reductions in the residential area and use primarily prefabricated elements in their projects [23]. Terrace modules are self-supporting and free-standing, mounted to the façade on similar principles as scaffolding. In both projects, only the foundations for prefabricated terraces were poured on site, thanks to which the assembly time and pollution during the construction works were reduced.

It is also important for the preservation of the existing community to counteract the uncontrolled gentrification of housing estates and to ensure comparable quality of living space for new and existing residents. Druot, Lacaton, and Vassal postulate to improve the quality of the living environment of the current tenants first and, then, create new apartments through superstructures and extensions. The design process should also be preceded by an analysis of factors by increasing the amount of rent. In both Bois le Prêtre and in Grand Parc, there is a dependence on the cost of modernization as opposed to the new area of the apartment. With a cost of reconstruction much lower than that of demolition and new construction, rents remain at the same level, especially since operating fees decrease despite the increase in the area. The additional living space is not heated; therefore, it does not generate additional costs.

Give what inhabitants need

The needs of tenants can be answered by collecting information and guidelines from current residents as well as by precisely and clearly communicating modernization intentions. The "Plus" strategy assumes modification of the usable area of the building depending on the demand of the residents, as well as the owner of common spaces, office spaces, and smaller or larger apartments. Thanks to cooperation with tenants and the appropriate management of the Bois le Prêtre skyscraper, 40% of the residents switch their apartments after the completion of the works to ones more suited to their needs [24]. The work on the revitalization of the Grand Parc housing estate included a number of participatory activities and consultations around proposals for individual public spaces. An information point was created where development plans, projections, mock-ups, and schedules were presented. In one of the modernized buildings, a demonstration apartment was arranged in which information about the schedule and renovation process, as well as noise and vibration stimulations, were displayed. Twenty residents went on a trip to the Bois le Prêtre skyscraper in Paris where they could take a closer look at the architects' earlier projects. Upon their return, they became ambassadors of the project among the local

community. A total of 389 households (75.53%) took part in a survey carried out at the end of the whole consultation process, and 91.77% of them supported the modernization (compared an average support of 25–30% for other projects) [25].

Plan

Detailed planning of modernization works in inhabited buildings and cooperation of various entities throughout the process are of great importance for Druot, Lacaton, and Vassal [16]. The Grand Parc housing estate revitalization project was initiated by local authorities which organized some public consultations and hired an architect and a landscape designer to create a comprehensive vision for the entire area. The second entity is Aquitanis: a public housing office in Bordeaux, which owns and manages social apartments with regulated rents. As the owner of most of the premises in Grand Parc, Aquitanis launched a closed architectural competition, as a result of which the Druot, Lacaton, and Vassal team won a contract for the project of modernization of buildings G, H, and I. Thanks to consultations with the residents, the reconstruction could be planned in detail, both in time and in financial terms. The schedule assumed that the modernization works per apartment would take 12–16 days, the assembly of prefabricated modules would take half a day, the dismantling of the old façade would take 2 days, installation of a new façade would also take 2 days, and renovation of the interior of the apartment would take 8–12 days [25].

Save

Recycling existing buildings, alongside careful and selective adaptation, allows for large environmental and financial savings. Separating the thermal insulation layer of the building into several layers—thermal curtains; double glazing; a winter garden which, depending on the season, accumulates heat or protects from overheating; and polycarbonate panels, equipped with curtains reflecting sunlight—help to reduce energy consumption by 50–60% [26]. In addition, large windows allow for easier ventilation of the apartments and support natural ventilation.

EUR 18 billion was spent on the national revitalization program in France over the past 15 years. Furthermore, 150,000 apartments were demolished and 100,000 new ones were built. The PLUS strategy is a big savings for the budget. In the Bois le Prêtre Tower, the final cost of modernization, which was high due to extremely difficult conditions, reached EUR 110,000 per flat (approx. 50% of the demolition cost), while in the Grand Parc estate, it was EUR 52,000 per flat (approx. 35% of the demolition cost). The number of flats has not decreased in either case. However, it is difficult for building owners to apply for public financial aid for a PLUS modernization, as the French state subsidizes EUR 150,000–180,000 per flat for demolition and new construction, or just EUR 20,000 for essential modernization [27] (p. 106).

4. Polish Exemplary Buildings

The analyses of the French realizations were compared to exemplary building solutions in Poland in two selected prefabrication systems in housing construction: OWT 67 (Figure 5) as the most popular system, and WWP (Figure 6) as a representative of the regional type of a large-panel block popular in the southern part of the country. Both systems were designed to create 5- and 11-storey buildings in different possible configurations. Proposed layouts of the typical solutions were chosen to provide two typologies of housing estates: vertical point access building in OWT 67 and corridor access building in WWP.

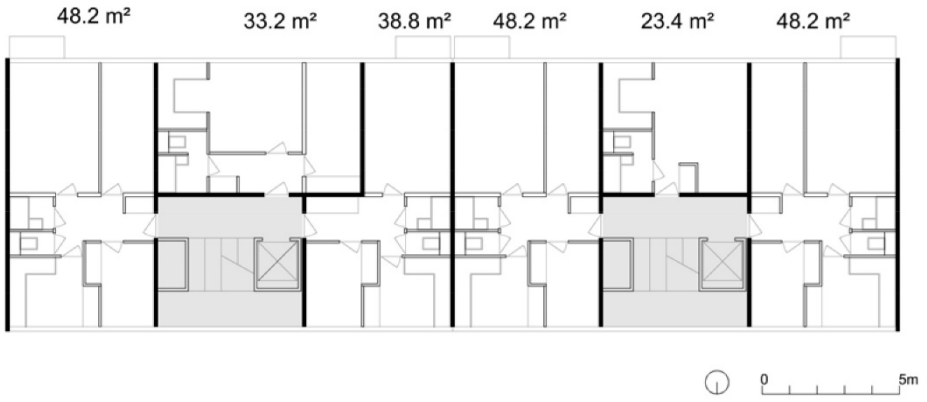

Figure 5. Plan of the exemplary building in the Polish OWT-67 large-panel system with information about the useable area of each apartment. Drawing by the author based on [28].

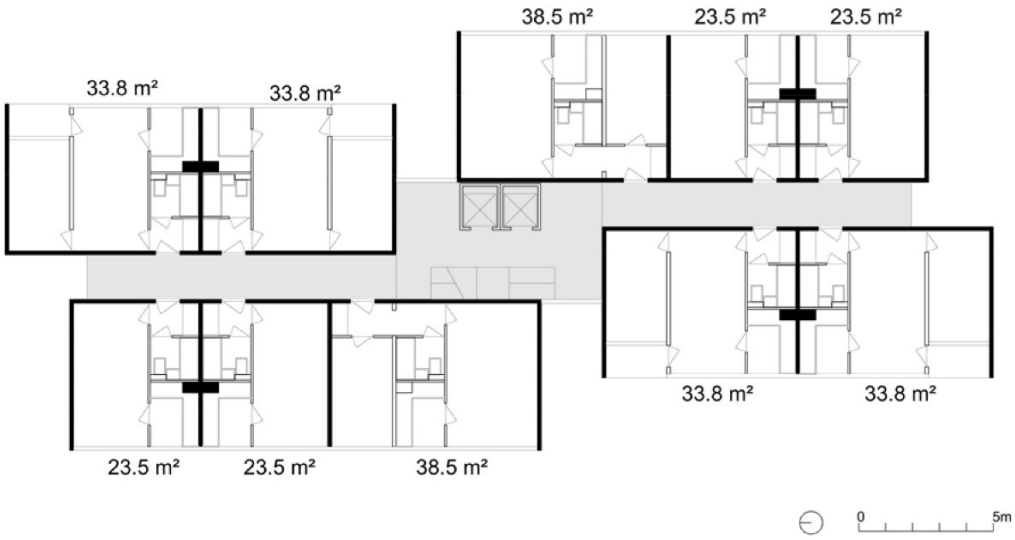

Figure 6. Plan of the exemplary building in the Polish WWP large-panel system with information about the useable area of each apartment. Drawing by the author based on [28].

The following assumptions were made for the analyses, corresponding to the most common situations in large housing estates, and enabling a comparison of French and Polish examples:

- both buildings were 11 stories high;
- buildings were oriented in accordance with the directions of the world so that the apartments were sunny (corresponded to Le Corbusier's modernist principle of providing access to light, fresh air, and greenery [19]);
- there were no commercial services on the ground floor;
- buildings were managed by housing cooperatives, covering all facilities included in the estate;
- the social structure of the inhabitants corresponded to the results of socio-demographic research on large-panel housing estates in Poland [29].

5. Results

The structure of the Results section corresponds to previously defined key principles in Druot, Lacaton, and Vassal's modernization projects. Each postulate was subjected to critical analysis and juxtaposed with the Polish context.

Never demolish, always add

The analysis of Polish post-war prefabricated buildings confirms the thesis that architecture itself is not the source of problems in large housing estates. Contrary to the predictions of researchers from the 1990′s [30,31], large-panel housing estates in Poland did not fall into the so-called "spiral of decline" or "large housing estate syndrome", i.e., the processes known from West Europe, leading to social, economic, and material degradation [29]. Large estates built by the socialist state were a part of the program of egalitarianization of the society. Housing was granted to young families to "build demography", not to members of a specific social class. The lack of housing slowed down low migration [29]. The status of these estates has not deteriorated since 1989. Their communities of residents are diverse in terms of material, social, and professional status. Living in a large-panel block estate is not perceived as socially degrading [32,33]. According to studies, housing estates are among the safest places in many Polish cities [34]. The spatial layout of the blocks or their architecture did not cause undesirable behaviors among their users.

The position of French architects regarding the non-demolition of large-panel residential buildings is, therefore, very accurate in the Polish context, and even the only one that can be followed. Additionally, 84% of apartments in Poland are owned (compared to the EU's mean rate of ca. 70%) [35]. The situation is different than in France where apartments in condemned housing estates are rented and are a part of the housing pool administered by public authorities or by management companies, so the relocation of tenants is possible. Most apartments in Polish large housing estates have the status of cooperative ownership (providing residents the rights of sale, inheritance, rental, etc.) or individual ownership (in which case they are managed by housing communities). The relocation of people from such a building is, therefore, very difficult and practically unheard of.

The prefabrication systems of both exemplary Polish buildings, as well as most of the large-panel solutions used in the period of the People's Republic of Poland, were based on the transverse structural system in which the external walls served as "curtains" [28,36]. This makes it possible to expand both buildings by dismantling the outer wall and widening the existing footprint.

The comparison of vertical point access buildings, i.e., part of the H and I buildings in Grand Parc Estate (Figure 7) and OWT-67 structure (Figure 5), shows that the depth of both is almost the same. Still, the flats in the Polish example are significantly smaller, as the modular construction grid is more narrow. As a result, the proportion of the living rooms and bedrooms are more rectangular (1:1.5 up to 1:2.5). Both buildings on each floor lack the shared space beyond the circulation zone, and the possibilities of its extension are limited just to one northern side.

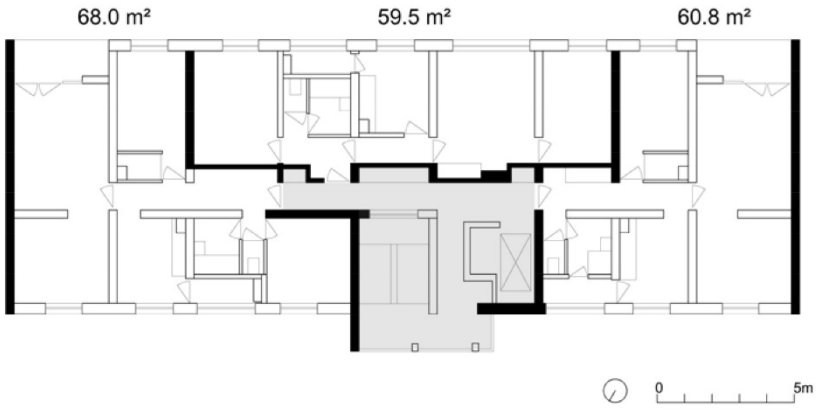

Figure 7. Plan of the part of the H and I buildings in Grand Parc estate before the transformation with information about the useable area of each apartment. Drawing by the author, based on [21].

In corridor access buildings, Le Tour Bois le Prêtre (Figure 8) is deeper than Polish WWP forcing the layout with kitchen away from the façade. The proportion of the rooms

are, in most cases, more rectangular in WWP structure. This plays an important role in enlarging the building by increasing its width. This solution strengthens the unfavorable proportions of the rooms. In this typology, both examples are subject to no shared spaces, but the structure of the circulation zone in Polish case enables extension on different sides of the buildings.

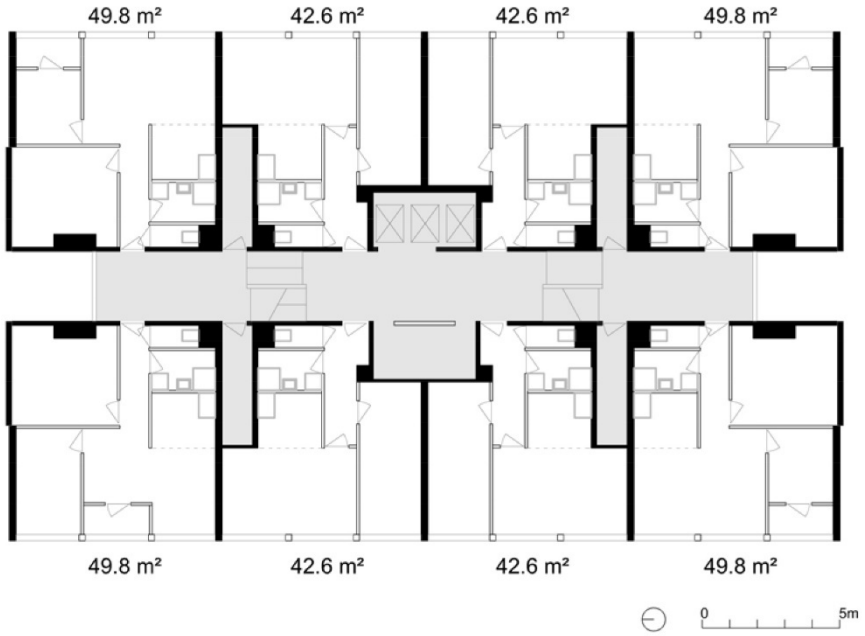

Figure 8. Plan of the Tour Bois le Prêtre in Paris before the transformation with information about the useable area of each apartment. Drawing by the author, based on [21].

As in French examples, Polish housing estates in OWT-67 and WWP large-panel systems include the inadequate accessibility of premises to people with disabilities, the clustering of services in one area of the estate, or the poor communication of the building with its surroundings due to raised ground floors. The measures proposed by the French architects could significantly improve functionalities of large-panel blocks. An example of Tour Bois le Prêtre show how the redesign of a landscape can provide a ground floor on the level of the exterior.

Provide luxury

In the Polish context, the introduction of the idea of luxury has a slightly different dimension. In France, the large housing estates described in "Plus" are usually social buildings, rented to lower-paid residents who cannot afford to change their apartment or district. In Poland, such facilities are inhabited by social groups diverse in terms of salary and cultural capital, which often do not look for, or find, an alternative on the housing market. Currently, they cannot afford new apartments from the "premium" market, and modern commercial projects often propose a similar or less favorable arrangement of apartments (deeper tracts, smaller area illuminated by daylight) in buildings. The common parts of this arrangement do not have access to light [37], and also have worse access to the social infrastructure, greenery, and public transport. The conversion of their current place of residence is therefore often the only possibility of significantly improving the housing conditions and creating a real alternative to the commercial developers' market. "Luxury" would become a universal and egalitarian benefit which is accessible to very diverse communities. Although some of the solutions proposed by the French architects are indeed top-shelf, the very enlargement of the living space seems to be a basic right in overcrowded Polish apartments (Poland has one of the highest overcrowding rates in Europe [38]). As the COVID-19 pandemic has also revealed, modern housing is not at all immune to any disturbances in the rigid spatial division into buildings and premises

intended for work and those for living private life, as well as to the potential compulsion of dwellers to separate from one other. Remote work in too small apartments has turned out to be very difficult, adversely affecting family life. This seems particularly difficult in large-panel buildings built in the People's Republic of Poland, where the surface norms of the time forced the design of small rooms (even 6 square meters), in which there is no place for versatility or changing the arrangement of furniture. The additional space proposed by Druot, Lacaton, and Vassal would therefore create a possibility of better adapting the existing housing stock to the recurrent waves of the pandemic and the likely permanent change in the work system. Drastic restrictions on mobility and the possibility of leaving home have also contributed to an increase in the demand for building plots in suburban and rural areas, intended for single-family housing. Among people who migrated for good within Poland in 2020, almost 50% are new rural residents (compared to 46% in 2019) [39]. The need for contact with nature and the possibility of being in fresh air has become a very important need of city dwellers. Winter gardens added by Druot, Lacaton, and Vassal, i.e., the "outdoor rooms", could be the first step to building a better connection between the interior and the outside world.

Furthermore, the winter gardens act as buffer zones between private and public spaces. Semi-private spaces may increase the interaction between the inhabitants, especially on the lower floors, and may provide the potential for better surveillance over the common space [40]. This semi-private space of winter gardens and terraces gives the opportunity for inhabitants to express themselves and present their lifestyles [41].

Widening the route entails the risk of deterioration of lighting conditions of buildings. Following the Polish legal provisions, an analysis of direct sun exposure in the WWP building was carried out [42]. The addition of winter gardens and terraces in a building aligned to the east–west axis is possible, provided that the total depth of the new structure does not exceed 2.4 m (Figure 9). Only then will the rooms' minimum direct sun exposure time of 3 h be achieved.

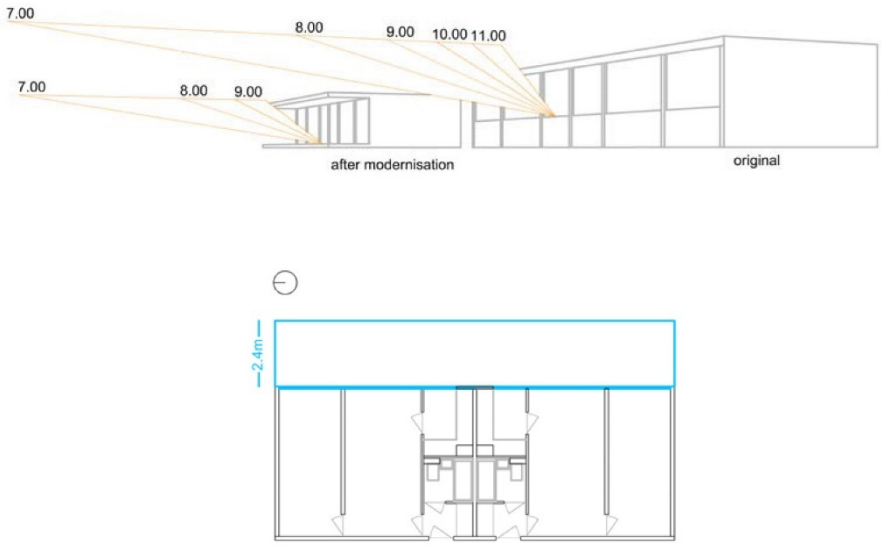

Figure 9. Analysis of direct sun exposure in WWP building. In the original version, direct light is provided on the days of the equinox between 7 a.m. and noon. In the potentially modernized version, direct light is provided between 7 a.m. and 10 a.m. Drawing by the author.

Enlarging the windows in the building does not increase access to light. The potential expansion shortens the access time to direct sunlight by 2 h. The same analysis for the southern façade in the OWT-67 building showed that the depth of the winter garden with the terrace could be 3.2 m max. Following Polish law, the depth of the added structure in the WWP buildings is 60 cm (20%) lower than in Tour Bois le Prêtre. Such a limitation significantly affects the functionality of the space and the possibilities of its arrangement.

However, the added area is a significant extension of the living space and amounts to approx. 40–50% of the current flat area.

Preserve the existing community

In Polish conditions, the use of prefabricated elements, in order to reduce the time of building extensions, is also justified. In the first quarter of 2021, labor costs increased by 5.8% compared to the previous year, which is 4% more than the EU average [43]. Although the average pay in Poland is still significantly lower than the EU average, there is more and more talk about a return to the prefabrication in construction, which could reduce, or at least give more predictable, costs of implementation. The use of prefabricated elements in works on existing large prefabricated housing estates seems to be particularly beneficial; they are modular and repetitive structures but also often require access to infrastructure, which supported the original construction work (e.g., the vicinity of railway routes, facilitating the delivery of heavy elements).

Indications regarding the potential increase in rents and, thus, the possible gentrification of modernized buildings are also important. Given the prevailing ownership of apartments in the structure of Polish estates, the process of controlling the amount of rents by subsidizing them is more difficult. A significant increase in their rents could, therefore, mean that many residents would not be able to stay in their current place of residence. The costs of modernization must, therefore, be balanced with potential subsidies and possible revenues of cooperatives or housing communities, and the design solutions must strive to reduce the operating costs after the revitalization of the facilities.

However, the aim to preserve the existing community might be an insufficient response to the problems created by large-scale housing estates, leading to anonymity and a lack of connections or social interaction among residents. Social interactions within the neighborhood must build trust between inhabitants, encourage sharing resources, and help grow social capital [40]. As in each of analyzed buildings, the number of inhabitants exceeds 100, the clustering of the shared spaces seems to be inevitable. Residents tend to withdraw from social interactions in too large communities [40]. Therefore, a hierarchy of common spaces should be introduced on a similar basis as in the co-housing communities [44]. The extension of apartments in Tour Bois le Prêtre need to be replaced in Polish exemplary WWP building with a shared space on each floor easily accessed from the circulation zone. Such rooms could be shaped like a flexible space, e.g., a joker room in Kalkbreite neighborhood in Zurich [44] Alternatively, it might constitute a functional complement to small apartments, such as added laundry or storage space. A lower number of flats per one access to the building in OWT-67 example helps to create a shared space on the ground floor or the roof per whole community. Expanding the entrance zone would also provide more space for shared facilities.

Give what inhabitants need

Because apartments were granted at the times of the People's Republic of Poland according to the demographic key, the population of Polish large-panel housing estates has been growing older since the 1990's [23]. However, this process has slowed down since the first decade of the 21st century and younger people, aged 20–35, often grandchildren of the original residents, have often been inheriting apartments. A significant increase in the number of students can be seen in academic cities [45–48]. Preserving the existing communities in Polish housing estates now means taking care, primarily, of pensioners, young families, and students. The process of "aging in place", i.e., older adults staying in their place of residence, requires adapting to an environment to enable them to function independently for as long as possible, by eliminating physical barriers and also reducing possible stress. Taking into account residents' initiative, consulting solutions, and informing them about planned modernization works is, therefore, of key importance [49]. This allows the retrofit design to be adapted to enable independent living and to alleviate feelings of confusion or insecurity.

Public consultation in the public sector is regulated by law, but this does not apply to private entities, such as cooperatives and communities. A particular problem can be seen in housing cooperatives as they are large, sometimes covering up to tens of thousands of apartments, which weakens the involvement of residents in current affairs and deprives them of a sense of influence on the decision making [50]. Making public subsidies subject to the requirement of public consultation could be a solution which forces managers to adopt a broad and clear decision-making process.

Potential changes in the structure of apartments and functional changes within buildings in the Polish context are hindered by the different form of ownership. However, even the French example shows that the extensive functional changes proposed in the theoretical part of the "Plus" manifesto—the introduction of offices, baths, or swimming pools, and the change in the structure of apartments—have not been implemented at all, or have been to a small extent, in the analyzed examples. The comparison of the two projects proposed by Druot, Lacaton, and Vassal show that the smaller scale of modernization implementations makes it possible to propose measures which are more appropriate to the needs of a community. The unification of the design of three buildings in Le Grand Parc, as well as the design of identical, non-individualized spaces on the ground floors, reproduces the original assumptions of large-scale housing estates. Creating a single building modernization project in Paris made it possible to propose spatial solutions that strengthen the community, which treats the building as a common good. As a result, 40% of tenants exchanged their flats. Public consultations played an informative role in large-scale modernization in buildings G, H, and I at Le Grand Parc (Figure 10), instead of providing a platform for developing common ideas and solutions. To avoid repeating the French mistakes, the implementation of the process in Polish housing cooperatives must involve a more complex consultation process based on working out solutions with the inhabitants of individual buildings.

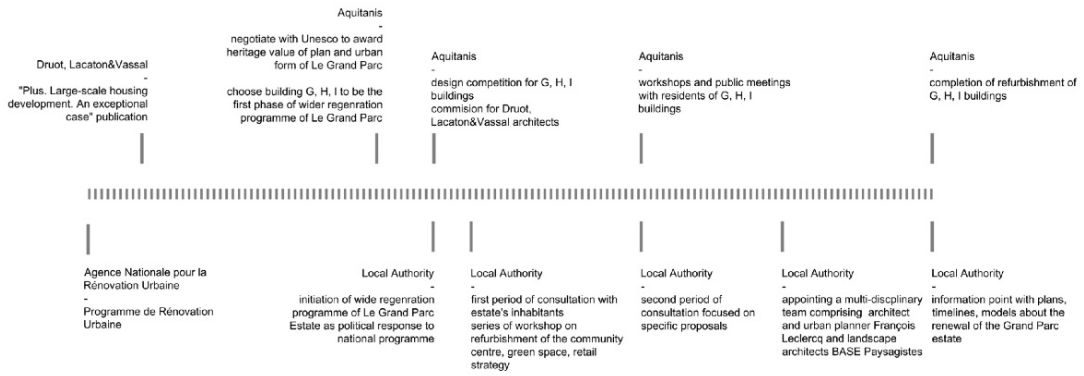

Figure 10. Timeline presenting actors and the process of modernization G, H, and I buildings in the Grand Parc Estate. Prepared by the author, based on [25].

Plan

As studies show, long-term planning and building a development strategy show the weak side of the activity of owners and managers of Polish housing estates, i.e., primarily cooperatives and housing communities [50,51]. Chaotic densification of an urban structure and ad hoc renovation works do not fully meet the changing needs of residents [52]. The lack of financial resources and limited access to specialists discourage managers from drafting comprehensive revitalization visions. Making use of the French example, however, makes it possible to create system solutions and "prefabricate" the modernization process.

Druot, Lscaton, and Vassal's transformation projects show that the national program of renewal is too narrowly defined, which may effectively prevent solutions that do not directly comply with the guidelines. If created in Poland, such a program should define stakeholders and the process of creating site-specific modernization projects.

Save

Polish post-war prefabricated buildings are undergoing thermal modernization on a mass scale. Reducing energy consumption has become a priority because external partitions exceed modern heat transfer requirements several times (the most commonly used external wall systems had a coefficient of U = 1.16 W/m^{2}K [2]). The heat transfer coefficients of external walls (0.24 W/m^{2}K) and windows (1.7 W/m^{2}K), which were achieved by the French architects after the renovation of the buildings of the Grand Parc housing estate [26], do not meet the Polish regulations in force since 2021: 0.2 W/m^{2}K and 0.9 W/m^{2}K, respectively [42]. This means that a direct application of the new façade solution proposed by Druot, Lacaton, and Vassal in Poland would have to take into account better insulation parameters of the materials used. The result would be higher financial outlays than those incurred in France. Another solution could be to treat all the layers proposed by the architects (windows, curtains, winter gardens, and polycarbonate panels) as a multi-layer wall; the winter gardens would then constitute a kind of air gap in the partition. Such an approach would require additional calculations and appropriate interpretation of the law on the part of local governments, or modification of the provisions of the law.

Taking into account that large Polish housing estates enjoy a good reputation and are not expected to be demolished, the financial calculations of Druot, Lacaton, and Vassal, proving that modernization according to their project offers a savings, are not applicable. In Poland, non-standard solutions and their costs will most likely be compared to the cost of the typical modernization, i.e., the application of a layer of polystyrene foam and a thin coat of plaster on the façade. Financial savings can only be considered in the long term; the increasing mismatch between the large-panel construction and modern housing needs will require repeated interventions and will give rise to costs of subsequent retrofits.

6. Discussion

PLUS and large-scale prefabricated housing estates in Poland

The analysis of the strategies and designs proposed by the Druot, Lacaton, and Vassal team for post-war large housing estates in France, and the test of their suitability in the Polish social, economic, and construction context, shows that the direct application of these architectural solutions is often difficult. The 3.8-m extension of buildings along the entire façades makes it impossible to meet the Polish legal provisions on the proper lighting of apartments, while the insulation parameters of the external partitions do not match the Polish climate and regulations regarding energy intensity. Due to the predominant private ownership in large-panel buildings, the functional changes of the facilities proposed in the "Plus" manifesto and the flexible approach of the structure of apartments are also difficult to implement. These solutions could be applied after adjustment to the Polish environment. However, the direct copying of the Druot, Lacaton, and Vassal's architecture raises other problems. The repetitiveness of the solutions of French architects can duplicate the original sin of the large-panel architecture. For example, identical concrete façades would be replaced by identical glass walls. Another problem with the transposition of the Grand Parc project seems to be the ground floors: inertly not building a relationship between the building and the surroundings and not providing space for social and commercial services, which are often lacking in Polish block housing estates.

It seems, however, that it is not specific architectural solutions that are the most important, but the underlying strategies and design philosophy. The proposals of the French architects should be more of an inspiration for unconventional thinking about modernization: treating a building as a starting point in the design process rather than a finished object that only needs to be improved. The wall is not just an external partition but a layered structure that defines the relationship between people and their environment and gives an opportunity for a smarter fight against climate change. The pandemic has revealed many housing problems that had, up until now, gone unnoticed and overlooked in the

design process. Modernization of the existing housing substance gives an opportunity to take into account the new needs of residents.

A weakness of Druot, Lacaton, and Vassal's strategy is focusing mainly on improving the quality of private housing and minimizing interventions in shared spaces. Such a decision allows for a significant reduction in project implementation costs. However, the imbalance between private and shared spaces investment does not solve the problem of large-scale facilities, including anonymity and weak unneighborly ties. Modernization and its process could be treated as a chance to create a model similar to co-housing communities.

The pursuit of the highest quality in modernized buildings and the way the revitalization process is carried out—close cooperation with residents, creating a coherent vision for larger housing complexes, and planning and creating development strategies—could be followed in Poland after shifting the emphasis and implementing programs absent France (due to other conditions). Numerous structural problems of Polish housing cooperatives, one of the main forms of management in large-panel housing estates, result in the lack of comprehensive revitalization strategies taking into account the voice and needs of residents [50,51]. A frequent phenomenon is also the fragmentation of administration within a single urban complex. The French experience shows that it is important for dispersed entities to unite and appoint project leaders to define goals and tools and lead the revitalization process.

Research on methods of preventing gentrification in large estates is necessary in Poland. Good locations and diversified social structures of the estates means that Polish cities do not need to struggle, as much as Western cities, with the problem of unification of the social structure in individual residential districts, displacing the worst-off groups to the outskirts and suburbs. In addition, the potential financing of the modernization of Polish housing estates requires analysis. Calculations that do not fit the Polish context force us to find different arguments for granting more funds from the state budget or to find another source of financing. The category of savings in the Polish context should be based on a different balance of profits and losses. Here, as in French projects, savings are based on the precise planning of costs in an attempt to balance them with profits from various sources of income, so as to burden residents as little as possible with increased expenses for housing maintenance. The potential here seems to be the large scale and credibility of housing cooperatives, making it easier for them to contract loans and spread costs over many years. This gives the opportunity to balance investments with savings on the reduction in operating costs. Additional funds can also be sourced from unused local reserves, often amounting to approx. 20–30% of the likely cost of modernization. Many Polish estates still have them because, in the post-war period, projects were rarely implemented comprehensively [52]. The changes in Polish estates after 1990 are deep, but their fragmentation and lack of coordination is their weakness [53]. Housing estates are chaotically densified by adding new buildings of a higher standard, by usually not fitting them into the spatial context and not referring to the architectural character of the neighboring buildings. The new, often-closed (so-called "gated") communities, formed in this way as parts of the former housing estates, do not improve the quality of life of the existing residents, and even lower their assessment of their own places of residence [53]. The construction of new facilities should, therefore, be the result of a coherent spatial development strategy for residential complexes. According to Druot, Lacaton, and Vassal, the introduction of new buildings should be preceded by, or implemented in parallel with, solutions which improve the housing conditions of the current tenants.

7. Conclusions

The proposals of Druot, Lacaton, and Vassal are some of the most revatalizing and modernizing strategies which are best adapted to the legal and social environment of Polish large-panel housing estates. The prevailing private ownership raises many complications when demolition, or even partial demolition, of an existing facility is required. In addition, the diverse social structure of Polish estates does not give rise to a problem of segregation,

which would be comparable to what we can see in France [54], which is the reason for the radical revitalization policy. The densification of buildings through the addition of extensions or superstructures to large-panel buildings offers primarily two options: it is an opportunity for the public sector to increase its housing stock, giving an opportunity to private entities (cooperatives or communities) to partially finance the renewal of their own estates. From the Polish perspective, the savings offered by the French architects, resulting from modernization instead of demolition, seem to be a rather wasteful extravagance (the Ministry of Investment and Development estimates the average cost of renovating a building at PLN 0.5 million [55]). On the other hand, renovating facilities without improving the quality of the residential environment in the long run may prove to be an additional cost instead of a saving.

The analysis of the Druot, Lacaton, and Vassal's "Plus" theory and modernization projects help to define tools that can be used in the Polish context. The French experience shows how important accurate diagnosis and close cooperation with residents are when operating on inhabited housing estates. Therefore, the selection of specific architectural solutions should always be preceded by a thorough analysis and definition of both technical and social problems within the target housing complex.

The combination of the categories of luxury and economy paves a new way of thinking. Maximizing the living space, quality, and freedom of living in facilities that are not part of the commercial luxury segment of the housing market can prevent an outflow of the wealthiest residents from large housing estates, and thus the potential gentrification and unification of the social structure in individual districts of cities.

In order for a modernization program of Polish housing estates to have a chance of success, it seems necessary to involve public entities in the process and supervise the implementation of works.

Recommendations

The recommendations summarize the analysis of the possibility of implementation Druot, Lactaon, and Vassal's strategies in modernization projects in Polish large-panel housing estates. They are intended to target various stakeholders involved in the transformation of post-war modernist estates.

It is recommended that the national authorities relate the allocation of funds to the value added by the modernization project in several sustainability criteria, by reducing energy consumption, strengthening social connections, and improving the functional layout of private space. At the same time, the flexibility of the funding criteria should be ensured to avoid the mistakes of an overly narrowly defined national revitalization program in France. It is also recommended to create a federal revitalization program that will determine a model process of housing estates modernization, including its subsequent stages and the role of various stakeholders.

Regarding local governments, it is recommended to create an open-access toolkit of possible solutions corresponding to the climatic conditions of the region, the most popular prefabrication systems in their area, and socio-economic conditions. A multidisciplinary group of researchers and designers should be engaged in such a process. A wide range of potential solutions will allow the actual participation of residents in the design process and strengthen the community through joint activities.

The final recommendation for housing cooperatives is to create a multi-annual development program, including detailed planning for the expansion of housing estates in a sustainable manner and improvement of the housing environment of all residents. It is also advisable to fragment the structure of the cooperatives. Self-governing groups of residents of one building would have their representatives in the cooperative board.

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