

Anita ORCHOWSKA¹

TECHNICAL AND ARCHITECTURAL PROBLEMS IN REVITALISATION OF PREFABRICATED RESIDENTIAL COMPLEXES

The subject of this paper are the issues connected with revitalisation of prefabricated residential complexes built in industrial technology. The article focuses on modernisation of prefabricated residential complexes in terms of architectural and technical issues of the buildings. The reason for this is the fact that there is a systematic improvement in the quality of housing environment and attractiveness of housing areas and also the issue of revitalisation should be popularized. Popularizing this subject in Poland serves to refute false information that the exploitation of these residential estates is coming to an end. Current research confirmed with the technical expertise on possibilities of further use and an unflagging interest in old 'high-rise housing developments' may be an encouragement for revitalisation works. In this paper the attention is paid to technical issues of the housing developments connected with building defects, exploitation damage, diagnosis and modernisation of the buildings and also the architectural possibilities of new solutions within revitalization. Additionally, the paper presents the results of the survey carried out among the residents concerning the architectural aspects of Sadyba residential estate in Warsaw and diagnosis of some problematic issues.

Keywords: revitalization, modernization, thermomodernisation, prefabricated housing estate, technical issues, image

1. Introduction

In Poland, contemporary programs of revitalisation of the housing estates concentrate on the invested areas but also on the ones coming from the period of prefabrication. The main aim of this activity is the current maintenance of the building objects, including carrying out thermal modernisation as well as transformations in the housing environments leading to an increase in their attractiveness. Housing standards represented by newly built housing developments of various aesthetics and spatial options force to think about more thorough revitalisation activities in comparison with an older commonly used tissue so that the disproportions in the quality of housing developments would not

¹ Anita Orchowska, Politechnika Warszawska, Wydział Architektury, Zakład Architektury Współczesnej, Wnętrz i Form Przemysłowych, ul. Koszykowa 55, 00-659 Warszawa; tel. 22 6282887; orchowska@poczta.fm

show such striking differences. According to statistics, half of the housing stock in Poland are the buildings erected in industrialised technology and so far half of the population in the cities lives in this kind of housing estates. Striving for an improvement in the standards of housing estates is also a sign of the growing interest in high-rise residential estates, especially among young and elderly people due to their financial capability of purchasing such a flat. For these social groups the most popular are the flats of approximately 40 m², which are situated in a good localization with a suitable communication access and functional facilities offered by the city or near the city centre. Another important factor are the hygienic conditions of the blocks of flats, the size of green areas and their development, solar exposure, which makes up for the poor aesthetics of slightly varied housing developments. The issue of revitalisation of the housing areas concerns mostly the communication and parking problems, the access to services within the housing estates and attractiveness of green and recreational areas. However, it does not refer to the issue of the housing development itself or any spatial changes in the structure of objects and the aspects of architecture. Meanwhile, in other European countries the industrialised housing developments are the main object of basic transformations, connected with partial rebuilding, reducing the number of floors, partial or full demolitions. In Polish conditions such drastic activities are not possible because there are not any uninhabited buildings in the housing stocks. What is more, the government does not finance any modernisation activities. The subject of revitalisation understood as a transformation of the buildings is looking forward to being popularised and undertaken in the near future also due to a lack of technically documented constraints for the future exploitation of the objects. Taking into account the current situation and real possibilities, transformations may include new architectural solutions of the common areas, stairways, entryways, improvements in a functional quality of the entrance space and aesthetics of the facades but also improvements in the technical standards of the prefabricated buildings. In this paper some of the architectural and technical issues concerning revitalisation of the prefabricated housing estates are presented, which are necessary for their further exploitation and improving the conditions and comfort of living in the buildings.

2. Basic concepts in revitalisation of the housing spaces

Revitalisation is commonly defined as ‘bringing back to life’ or a renewal of the neglected parts of the cities with the help of many coordinated undertakings in social, economic, spatial and ecological spheres. Revitalisation of housing developments built in the industrial technology is directly connected with the degraded housing development, neglected surrounding areas, a program of services functioning in the housing development and a social program concerning inhabitants of the housing estates. The activities should be carried out in many precisely defined areas such as technical, architectural, urban and social ones. They also should be done in accordance with the scale of the destruction of the

tissue or depreciation of the space and the inhabitants' needs. Modernisation of the buildings itself and their infrastructure is a separate issue connected with a technical condition of the buildings. In Polish conditions, it is difficult to carry out modernisation due to a lack of possibility to do any internal works directly in the structure of the flats and buildings.

The concept of 'revitalisation', according to 'The Revitalisation Act', is understood as 'a process of moving the degraded areas out of a state of the crisis, conducted extensively through integrated activities dedicated to a local community, space and economy, focused territorially and carried out by the interested parties of the revitalisation.' [1] Although the law does not directly refer to prefabricated housing estates, it clearly defines the degraded and revitalisation areas. The degraded area, according to the law, is the one with the concentration of the negative social phenomenon, but also spatial, functional and technical ones: 'degradation of the technical conditions of the building objects, including the ones serving the housing purpose, and non-functioning of the technical solutions enabling an effective use of the building objects, particularly in the field of energy-saving and environmental protection.' [1]

Modernisation is the concept commonly applied and functioning interchangeably with revitalisation. However, it has a completely narrowed meaning, referring to the technical side of the objects and the elements of infrastructure. Modernisation is part of the revitalisation activities of residential estates and might be understood in many ways, for example, as beneficial changes, modernising a building object, enhancing its value of exploitation, functioning and aesthetic values in accordance with current trends or fashion. However, this concept does not exist currently in the Building Law and various terminology is used interchangeably, such as extension, transformation, or renovation (as restoring the original conditions, not being the current maintenance). It is not correct to use the concept of 'modernisation' in terminology connected with building activities and administrative decisions. [2] A similar case concerns the word 'restoring', which is replaced with 'renovation' in the nomenclature.

Revitalisation is an element of the whole socio-economic strategy of urban development and one of its aims is the improvement of living conditions and housing environment. The chances for success have only the activities, which include cooperation between many partners such as authorities, social organisations, local councils, housing co-operatives, local communities and other participants, for example, designers, contractors, and coordinators. The key to success is the ability to cooperate together with particular local partners and creative involvement in the transformation process.

3. Review of the systems and technical issues in conducted modernisation of the buildings

Using multi-dimensional prefabricated elements in housing developments has been observed in Poland since the second half of the 50s. The first ones were

prefabricated hollow core slabs, so called, 'Żerańska brick'[3]. In 1957 the first building of large prefabricated concrete panels was erected in the PBU-Jelonki system and in 1961 in the WUF-T system. We can talk about some regional systems, which spread in the 60s such as Winogrody, Domino, 'J', and, which operated with sets of finished buildings. Central systems of large prefab concrete panels, such as, OWT-67 and WUF-T were also produced, which offered sets of components, prefabricated elements within typical units and buildings. In 1967 so called 'open' systems appeared, for example, 'Szczeciński system' and W-70.

Their characteristic feature was the base (type series) of the prefabricated components and typical connectors, which gave the possibility of constructing flats and buildings with different functional layouts. [4] It might be mentioned that in Poland from 1970 till 1989, 24 systems of large prefab concrete panels of housing development, in their basic and modified forms were used [5]. After the period of fascination connected with planning huge residential estates and numerous realizations of spatial development strategies, the time of 'doubts came, which brought the nostalgic longing for lost values of the urban space', and it was followed by a wake-up call in the 70s [6].

'Production' of the space full of monotony created by the system, turned out to be faulty. Large-panel building systems contained many mistakes in their construction and utility. Because the anonymity of the tower blocks and flats was criticized, more distinct character of the buildings was introduced by individualisation of the details of entrances or balconies. It was difficult to eliminate the anonymity of the flats due to a large number of similar features in construction methods and repetitive layouts of the flats. [6] In the 90s, when the production of the prefab systems was finished, time for conclusions came.

It was then that technological and construction defects appearing in the buildings were emphasized together with bad functionality of flats. The assumptions of modernisation defined at that time described works, which should be carried out to maintain the buildings in such conditions so that it would still be possible to use them and to ensure the inhabitants about the elimination of any 'defects'. Transforming, modernising and upgrading the buildings was the main subject of many thematic conferences,[5] reconstructive pilot plans and activities within the international cooperation with Germany, which after 1989 introduced a widespread revitalization program of housing estates.

Thermomodernisation of buildings was a very common activity, which in the 80s became more complex and was conducted in order to lower the costs of exploitation. Building envelopes, external walls, constructions of the flat roofs walls and the ceilings of the basements were insulated and installations were modernised. It turned out that the main defect of building the walls were thermal bridges and their influence on yet very low thermal insulation of the building envelopes in buildings constructed of large prefab concrete panels. The situation was regulated by the law on supporting thermal modernisation works in December 1998. It enabled cooperative societies to apply for publicly available investment loans to carry out modernisation works connected with enhancing the insulation of the

building envelopes and modernisation of the internal central heating installations. The research conducted in the late 90s by the Building Research Institute on buildings of large prefab concrete panels proved that except of insulations of the building envelopes it is essential to limit 'the exchange of the air in the flats and stairways' and replace the glazing with better parameters of the U-value. [3]

In March 2009, the Act on supporting thermomodernisation and renovations came into force [7]. The law in its new version, together with suitable regulations, defined the activities and regulated procedures of conducting energy and renovation audits.[8] The law also defined a 'thermal modernisation project' and it was understood as an improvement to 'lower the energy demand supplied for the needs of heating and warming drinking water (...), an improvement, as a result of which, there is a reduction in the loss of primary energy in the heating networks' and centralisation of the heat sources for residential buildings and so called collective dwelling. Under the Act 'a renovation project' is about renovations connected with thermomodernisation of multi-family residential buildings, including balconies, glazing replacements, supplying installations and necessary equipment but also 'transformations of multi-family residential buildings, as a result of which, their improvement takes place.' [7]

In 2015, the Revitalization Act, which was mentioned before, came into force. It presents a set of general rules of conducting this process putting the emphasis on ensuring social participation and preparing detailed analyses as the base for corrective actions. The act does not regulate, however, any particular rules of carrying out revitalisation. It does not refer to any financial issues and does not mention appointing a person, so called, 'revitalisation operator', to carry out any activities in the best public interest. For the first time the law mentions the issue of revitalisation, referring to the degraded areas, so it gives a chance for a reversal from the negative trends, for instance, by restoring the greatness of residential areas and also improving housing standards while taking into account the needs of local communities. [9]

Summing up all the activities, which have been done so far in the field of revitalisation, it should be emphasised that in Poland, except of thermomodernisation, any other works, neither complex nor partial, connected with the planned revitalisation of prefab housing estates were carried out. However, even the issue of thermomodernisation raises many doubts. Firstly, such activities require continuation and improvement and, secondly, they do not have any particular influence on the changes when the character of housing developments and their aesthetics are considered, let alone the improvement in living standards. They just serve to keep the buildings in a condition that is suitable for use.

Thirdly, the support of housing co-operatives in the field of thermomodernisation have not been sufficient enough so far and these works were just odd activities, often carried out thanks to financial resources obtained by the heads of the co-operatives boards. What is more, the country policy in terms of financing, turned out to be insufficient and made it impossible to carry out thermomodernisation works at the expected level. [3]

Referring to the work entitled 'Precision of Completion and the Necessity of Modernisation of Large-Panel Buildings', in which the authors made an analysis of sample thermomodernisation works in the prefab buildings from 70s, 80s and 90s in the residential estates in the Lubelskie region, some conclusions might be quoted. Thermal insulations of the facades were carried out in the 'light-dry' method from mineral wool and was coated with concrete slabs on the steel or wooden reinforcements or in the 'light-wet' one, which was insulated with Styrofoam and covered with thin-coat plaster on fibreglass mesh. It turned out that the 'light-dry' method was better because it provided better ventilation and after thermal insulation there are not any problems with mould and the rooms' humidity. After conducting the analysis of modernisation works in the prefab buildings, it might be concluded that the applied method of thermal insulation turned out to be merely satisfactory. However, heat losses were observed in a vertical and horizontal directions in particular zones, for example, through joints with the basement ceilings, in the areas of plinths and walls adjacent to the elevators, near cantilevered balconies and window frames, jambs, cornices, concrete lintels and at joints with insulation panels. This means that thermomodernisation solutions are not complete and require further improvement, possibly another thermal insulations and eliminations of new point and linear thermal bridges, and particularly 'bonding texture layers with the construction layer of the slab and modernisation of the building by using mechanical heat recovery ventilation' of the prefab buildings. [3] All activities should serve to lower the maintenance costs of the prefab housing stocks and increase the standards of their further exploitation, especially in technical and energy terms.

4. Diagnosis of destructions and current trends in revitalisation of the residential estates in Poland

Current trends in revitalisation of the prefab housing estates are focused on the activities, whose aim is to carry out a credible diagnosis of functional and technical issues. The research serves to refute the opinion about the forthcoming end of their performance abilities and is also the basis for elimination of any defects and modernisation of the buildings. According to a lot of studies conducted by the Building Research Institute, there are not any indications that the end of exploitation of large-panel constructions and tower blocks is coming in the nearest future. Durability of the buildings, defined as the ability to fulfil certain required functions, may be estimated to be at least 100 years, however, the exception are the prefab components, as defects in their production and assembly are found and also some negligence in their maintenance and repairs. [10]

Nowadays, the buildings should undergo technical inspections and maintenance controls, especially when it comes to components exposed to the negative effects of atmospheric conditions and factors appearing during their exploitation. Current requirements in terms of energy-saving and thermal

insulation parameters are more restrictive than they were when the buildings were erected. That is why, another current thermo-insulation works are carried out in the building objects, which previously underwent thermomodernisation. However, such activities may lead to an excessive load on the hangers of concrete texture layer and, as a result, it might be necessary to reinforce their connectors. [10]

According to available technical publications, large-panel buildings are stable objects in terms of their durability and do not pose any direct threat to residents. The damage caused by improper exploitation may be divided into two groups, the traditional one related to partition walls, coatings, ceilings and installations but there are also destructions caused by technological errors relating to internal and external walls, ceilings and balconies.[11] The assessment of technical conditions and safety of construction of prefab buildings (conducted by BRI) proves that the biggest problem are the triple-layer prefab components of external walls. The most common destructions include falling off the texture layers, decrease in insulation of the warming layer, defects and wearing of the joints, faulty binding of the prefab components by connectors and their corrosion, destructions of ceilings, external wall elements, joinery of installation, and the areas of lifts and rubbish chutes. [12]

One of the basic ways of assessing the buildings' safety is the diagnosis of the connectors of the prefab components and hangers in triple-layer external walls. The inspections of constructions, analysis of destructions and cracks are done by experts through cut-and-cover and visual methods. They mainly rely on taking samples for tests, analysing the results and making statistic calculations. Current non-destructive diagnostic tests involve scanning walls and ceilings' surface, defining position and diameter of reinforcement, the condition of anchor bars and their placement and they also predict where the corrosion of reinforcement may appear. These are the methods, which have the future in the diagnosis of destructions due to the fact that residents often do not approve of doing cuts in the walls of inhabited flats. The conducted diagnosis of different types of prefab buildings shows that construction safety after the years of use is not threatened. However, experts do not rule out possible dangers in case of malfunctions, which took place at the stage of production, assembly, during improper exploitation and maintenance of the buildings. [13] The trends in revitalisation of building objects move towards implementing a program of complex renovation works of construction systems preceded by diagnostic tests. In Poland diagnostic and material tests of destructions and technical conditions of housing developments should be carried out in accordance with current standards of building inspections. Renovation and modernisation works should include such elements as an improvement in the safety of using prefabricated slabs, fixing balconies, loggias, and also complete thermal insulation of objects. There should be an improvement in ventilation systems and airtightness, a replacement of installations and heating equipment, an improvement in energy balance of objects and microclimatic comfort of the flats but also in the image of architectural objects. [14]

5. Problematic architectural aspects

Architectural transformations within revitalization are an indispensable element of improving living conditions, the comfort of using the objects and their aesthetics. In Polish conditions, any changes interfering with individual flats are not possible, only transformations in the areas of common space are allowed. It is possible to implement functional changes within flats, their connections, extensions of stairwells, lifts, transformations of the ground floor entrance areas, building additional rooms for bikes and prams and improving the access for the disabled. Additionally, changes in buildings' facades and possible ceiling transformations, for example, in the form of extensions or new roof constructions, are necessary.

While executing functional changes, there are new holes made in internal load-bearing walls of the buildings and that is allowed by the construction of a building. It is followed by stiffening the walls with new holes only through internal load-bearing walls. What is more, a load-bearing wall may be treated as stiffening one by increasing the capacity of a load-bearing internal wall. Inner holes may have bigger width while external strip should be kept intact by the edge of the construction. [15] Changes in the facades and flat roofs should be carried out within the load-bearing capacity and should require in-depth constructional analysis.

6. The example of Sadyba residential estate in Warsaw

In practise, revitalisation of the prefab residential estates is not very common in Poland but it is very up-to-date and needed. To popularize the possibilities of architectural transformations and to familiarize the residents of the estates with the problems of their living place, a survey was conducted within the seminar "Revitalisation of the Housing Development" by the students of Architecture at Warsaw University of Technology. It concerned the quality of housing environment, conditions of building development and their aesthetics. The residents answered the questions on such issues as: the conditions of building development and their aesthetic preferences. On this basis, the key problems were defined. Additionally, there was an inspection of eastern part of the housing development and some 'sensitive' areas. It resulted in creating a base of solutions of architectural concepts, which were put forward by the students.

Sadyba is the residential estate, which was built at the end of 60s, in the typical housing development in the large-panel construction system 'Ż' - Żerańska brick. This system was based mainly on wall slabs made of aerated concrete and 1.5 meters wide ceiling channel slabs. The internal walls were made of ceramic brick, which at the same time allowed quite big freedom in creating solutions for flats and buildings. The use of a typical construction of the blocks of flats in Sadyba was balanced with developed arrangement of greenery and recreational areas. Some of the buildings had flats for disabled people, which was an innovative approach towards design issues. Currently this housing development is in a quite good technical condition. It represents typical and not varied facades and also monotonous architecture of the blocks of flats.

The conducted survey was multi-range but in this paper only the results concerning the housing development itself will be included. 90 people took part in the survey. The residents expressed their opinions on such topics as the aesthetics of the buildings, their technical conditions and preferred modernisation changes. The results revealed that according to the residents the aesthetics is rather good (58.2%) and almost 10% described it as very good. The visual image was evaluated as rather bad by only 13.2% respondents and bad by almost an equal number of 15.4%. The residents also assessed the technical condition of the buildings and for majority of respondents it is very good (21.1%) and rather good for 63.3%. When the questions about the buildings and flats are considered, the residents would be interested in enlarging the size of their flats (26.7%), functional rearrangements (15.4%) and equally important is improving ventilation systems (17.4%) and acoustics of the buildings (17.4%). The residents expressed their willingness to insulate facades (14%), change the size of the balconies (12.8%) and showed a significantly smaller interest in enlarging the windows (7%). The biggest group of respondents did not have the opinion on the subject of transformations inside the buildings (40.7%), which is quite a sad result. When the question about the expected changes in the staircases and entrance areas is considered, the residents were mostly interested in building more lifts (42.2%) and 28.9% expressed their willingness to make rooms for pushchairs. It means that the residents realize that it is necessary to transform entrance halls of the buildings in order to improve the comfort of living. However, only 6.7% respondents wanted to enlarge the entrance enclosure zone of staircases and 14.4% people were interested in building driveways for pushchairs. A big number of respondents did not have any expectations (25.6%) regarding the changes of entrances in the common space.

The survey revealed some discrepancies between the residents' opinions and real assessment of the needs in the diagnosis made by independent observers. It shows that a flat is still a deficit commodity in Poland and the residents feel some concern about losing it or the necessity of changes in their housing environment. The residents do not hide their concern over an increase in rents and any other costs connected with maintaining the objects and residential infrastructure, which may appear after revitalisation. Lack of consistency in opinions is also connected with a low level of awareness of current standards functioning around the world and expectations, which should be fulfilled by housing developments in cities.

7. Conclusions

Revitalization of the prefab residential estates requires the attention of the government, coordinated programs and financing the activities connected with the improvement of the whole housing environment. Complex modernization works preceded by diagnosis of technical conditions require bigger participation of the owners and administrators. What is more, they should be carried out on higher constructional and more functional levels concerning at least common space in the buildings. During technical inspections it is necessary to check critical elements

obligatorily, which are connected with the prefab system, construction and exploitation level of substances. A system method for diagnosis within created standards should concern the technical and energetic issues but also living comfort and even the image of architectural objects. Architectural changes are an indispensable element, which is integrated with modernisation of the building structure. No matter what the residents' opinion is, communities of experts should popularize this issue and revitalization activities in order to adjust the prefab housing estates to modern standards.

References

- [1] Revitalisation Act of 9 October, 2015, (<http://prawo.sejm.gov.pl/isap.nsf/download.xsp/WDU20150001777/U/D20151777Lj.pdf>) {access 10.05.18}.
- [2] <http://www.bzg.pl/node/239#> {access 28.05.18}.
- [3] T. Taczanowska, A. Ostańska Precision of production and the necessity to modernise prefabricated buildings, *Dom Wydawniczy MEDIUM*, pp. 15, 130–132, 172, 141, 154.
- [4] Wierzbiński S.M. : Problems of modernization of large-panel buildings. Technical possibilities of modernization of large-panel buildings and their actual conditions. Conference materials, the Building Research Institute, 1999, p. 12.
- [5] Baranowski w.: Economic aspects of maintaining and modernising large-panel buildings. Technical possibilities of modernization of large-panel buildings and their actual conditions. Conference materials, the Building Research Institute, 1999, p. 30.
- [6] A. Basista Heritage of concrete, *Wydawnictwo Naukowe PWN*, pp. 129, 124, 2001.
- [7] The Act of 21 November on Thermomodernisation and renovation support, 2008 (<http://prawo.sejm.gov.pl/isap.nsf/download.xsp/WDU20082231459/U/D20081459Lj.pdf>) {access 30.05.18}.
- [8] <https://nape.pl/pl/ustawa-o-wspieraniu-termomodernizacji-i-remontow> {access 30.05.18}.
- [9] http://www.rpo.wzp.pl/sites/default/files/pliki/ustawa_o_rewitalizacji_praktyczny_komentarz.pdf {access 30.05.18}.
- [10] <http://www.izolacje.com.pl/artykul/id2304,techniczne-mozliwosci-mieszkaniegobudownictwa-uprzemyslowionego?p=2> {access 08.06.18}.
- [11] Tomaszewicz D., Obolewicz J.: Identification of technical condition and prediction of safe durability of construction of large-panel buildings, *Modern Engineering* 1/2006, p. 104.
- [12] <http://www.izolacje.com.pl/artykul/id1539,diagnostyka-techniczna-budynku-wielkoplytowego> {access 08.06.18}.
- [13] Wójtowicz M., Możaryn T.: Assessment of technical condition of constructional connectors in large-panel buildings based on research <http://www.awarie.zut.edu.pl/files/ab2017/referaty/08/08-09%20-%20Wojtowicz%20M,%20Mozaryn%20T%20-%20Ocena%20stanu%20technicznego%20zlaczy%20konstrukcyjnych%20budynkow%20wielkoplytowych%20na%20podstawie%20badan.pdf> {access 09.06.18}.
- [14] Piotrowski J.Z., Zaborek R. The program of renovation works of the construction system, with the examples of W-70 buildings, *Construction and Architecture* 13 (3) 2014, pp. 47,48.
- [15] Ligęza W.: Synthesis of technical issues in revitalisation of large-panel buildings, *Construction Review* 6/2015, p. 62.

Przesłano do redakcji: 24.07.2018 r.

Przyjęto do druku: 28.12.2018 r.