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PROBLEMS OF THE LARGE-PANEL BUILDINGS ENVELOPS

This paper gives an overview of housing in Poland, presenting the main problems and needs identified in the urban building envelopes. Actual needs of the modernization of large-panel buildings have been presented, taking into account the structural, thermal and aesthetics aspects. The model of improvement of such buildings in Poland have been discussed and illustrated with examples. The possibilities of further improvement have also been analysed.

Description

In Poland, prefabricated building technologies were used in order to meet the social dwelling requirements, and also to reduce the cost. The simplest solution was the mass-production of dwellings. The goal of introducing the prefabricated building elements was to accelerate the time of assembling and increase the overall number of ready-to-use houses. Due to still high cost of living, the large panel buildings are going to be used in the future. One possibility is, the adaptation of these buildings to actual housing and servicing social needs [6].

The scale of the problem causes the necessity of modernization of these objects. But to carry out the adaptation entails considering the requirements of the occupants. This refers to functional solutions, installing of the equipment and satisfying living conditions. Yet in view of lack of flats in Poland as well as limited possibilities of financial state, and also small affluence of society, such buildings will be still used. The decisions about retaining and modernization of existing large panel buildings is well founded. The number of habitable buildings made in this technology in years 1950-1990, is about 50% of all dwelling buildings in Poland [2].

1. Building physics aspects

1.1. Thermal insulation

The increase of thermal comfort in existing dwelling houses is needed. Until 1998 the thermal insulation was a problem in Polish buildings. Until that date

the U value of the building envelopes was very high, because of very low layer of insulation was used.

In 1998 the new document about the building thermal performance was published, in order to satisfy the peoples needs of having better hygiene and comfort conditions. This regulation was aimed to control the energy consumption for thermal comfort purposes, promoting the use of insulation. A lot of block of flats were built according to previous standards, before the publication of the new thermal regulation. Their thermal performance is inadequate in almost all those cases. In spite of this reality, the thermal rehabilitation is now a common practice. The thermal insulation is still a big-scale problem that must be solved. Some solutions can be:

- the replacement of the old window frames by solutions with improved U value,
- the application of an exterior thermal insulation solution.

This situation could be solved with the improvement of the general building insulation level and with the control of the indoor ventilation rates.

1.2. Moisture insulation

There are a lot of problems with existing roof covers in Poland. The composition of the existing roof's covers must be changed due to the climate conditions. In the low buildings change of roof shape seems to be rational solution. While changing the shape of the roof we can alter the shape of the building and make its renovation. We can also have possibility of increasing number of flats in existing building.

The moisture insulation is a problem. The main reason is linked to ineffective insulations of roofs and exterior walls. Another reason is particularly related to faulty ventilation in the rooms where the moisture is produced in bathrooms and kitchens.

The most important effects that result from these problems are: building materials' degradation, health problems and user's discomfort. This problem is present mainly in flat roofs, in windows, especially in connections between the frames and the exterior wall and in the connections between the structural and the other exterior building elements.

These are the possible solutions for this problem:

- the improvement of the quality control during the works, in order to guarantee a perfect application of the insulation,
- the use of wall system with better moisture insulation performance.

1.3. Acoustic insulation

The acoustic comfort is now an important constraint for Polish dwelling buildings. Big number of occupants of flats indicates acoustic problems in such buildings.

The high mass of the conventional construction systems contributes to the satisfactory sound insulation level of the vertical partition elements. The majority of the problems are related to horizontal partition elements between a commercial area and a dwelling, due to inadequate airborne sound insulation. The low impact sound insulation between dwellings is another cause for complains. At the exterior envelopes, in most cases, the problems are linked to the low quality of the windows and their frames.

This problem results in health problems and discomfort. Some solutions to solve this problem could be:

- replacing the existing windows and installing the new ones,
- the use of resilient floors.

1.4. Dangerous materials

The presence of dangerous materials in the Polish dwelling buildings is a problem. The most dangerous materials found are: asbestos, formaldehyde, toluene and xylene. Asbestos is present in external walls. This material causes some health problems like, for instance, cancer. The formaldehyde is present in the wood used in the buildings. This chemical leads to some health problems in the respiratory system and is present in wood-based finishing (floors, doors, window frames, etc.) and in furniture. This problem is avoided if the wood is used in its natural state.

Toluene and xylene are two of the most used chemicals in construction. These chemicals are present mainly in paints and varnish with synthetic solvents. It could be avoided using latex and water based paints [7].

2. Architectural and urban aspects

2.1. Source of architectural and urban problems

Present-day housing and servicing building results from social needs. New community needs for bigger living area allows the to form and implement a variety of forms and unique shapes with bigger momentum to form with bigger momentum and implementing the variety of forms and unique of shapes.

The question arises: what to do with the large-panel buildings, which form monotonic housing estate development, built in previous years?

Adapting the large-panel building to the present-day social needs requires introducing constructional changes such as strengthening of the construction, roof shape modification, changing the span of usable rooms and adapting to the new requirements of heat energy consumption. All of those changes are to adapt large-panel buildings to the present day needs and to meet functional and aesthetic expectations of users [9].

2.2. Modernization of existing large panel buildings

The aim of examining the theoretical possibility of introducing architectural changes is to decide if the design works in these types buildings. To fully assess the possibility of modernization, accurate constructional calculations must be made, because the existing design does not include them. In each case one should obtain all the agreements and permissions required by the regulations of the building law.

Modernization creates new possibilities of architectural view of the building. Carrying out the full modernization when undertaken together with adding new balconies and loggia and introducing high roof and suitable form, creates a change of the building's envelope. General conception of superstructure should fulfil requirements and standard decisions.

Conception of superstructure takes into account technical solutions of building additional storey. There is a question of perpendicular transport in 5-storey buildings. In this case external lifts are possible to use, what makes convenient access to individual flats.

Superstructure and then sale of new flats can be source of financial resources maybe onto modernization of large slabs buildings. These investments are remunerative in view of zero costs of terrain, footing and existing technical infrastructure.

3. Planning aspects

3.1. Urban planning

In Poland (1945-1990) many apartments were built as quickly as possible herefore only indispensable elements were built in housing estates, so the people can live there at all. From the architectural point of view is the implementation of only the main elements of the structure of the settlements. But from the architectural point of view, this is only the implementation of the main elements of the structure of the settlements.. This usually concerns public utility structures, which determine the social content of the estate. That situation was more noticeable in the huge estates. From the time of construction of the estates the situation does not change until now. The design for estate did not include a social screenplay for its development. In was impossible to foresee what and when people will need [1].

The contractors were acting spontaneously, as it was being dictated by the economics of machine use. One allowed the investors intention to be dictated by the constructors. Designs of mass housing were done for anonymous users. Typical planes of flats were used. Design of too large housing complexes was a big mistake. Sometimes they were done for 40-80 thousands people. This situation was criticised by users of this estates.

The lay out of the housing schemes from 1950 to 1980 followed as a rule the ideas in town planning generally accepted in the 1930s. Typical blocks of buildings were preferably placed north-south and with equal distance to give all apartments the same access to a maximum of light and air. The residential function dominates these settlements areas. Other function didn't exist on these areas. It is necessary to add other functions, which are needed to create a real townscape. Another thing is to create relation between settlements areas and town centre areas by establishing new roads, and public transport system.

3.2. Urban facilities

First floor area in existing large-panel dwelling buildings like others floors in this type of houses are used for dwellings. For changing the occupant's quality of living, the houses should have new functions for example: shops, restaurants, clubs, recreation areas, cultural service, etc.

As mentioned above, the industrialised housing schemes from that period, suffer from a lack of urban facilities. The big scale and the privacy of the ground floor level, often create a uniform and non-stimulating environment.

In order to change that situation it might be considered:

- to open up the ground level indoor areas for new function,
- to provide the estates with small shops and offices.

One can observe the economical and socio-cultural development of Poland in the last seventeen years.

A great number of structural problems have not been solved. There are many problems that still persist and some of them have even been aggravated. The consciousness of the transformations that took place after the democratic revolution in 1989 have been carried out at an urban level, with intervention of local authorities, in order to insure a better connection between the dormitory areas and the other parts of the urban landscape, only took place in the middle 90's when it was already too late. Mistakes that were made in the previous period led to problems that now are very difficult to change, such as the lack of green and leisure areas, the formation of urban "ghettos" in Polish cities. The buildings built before the appliance of the new thermal regulation codes (1998) were not designed to be compatible with the local environment and, in consequence, show a poor thermal performance and several types of malfunctions.

These problems are not easy to deal with but some solutions can be pointed out to minimize their impact. In this sense it is essential, for instance, that local authorities provide common facilities for the inhabitants of the "dormitory" areas such as kindergartens, green areas, small shops, office areas, etc. In other words, the urban public transport planning must be enhanced in order to create efficient transport networks.

4. Land use aspects

After 1989, private promoters found a fertile soil for speculation and disordered construction on non-regulated urban areas expansion mainly in the suburbs of major cities, but also in other regions. In most cases, Architects were not involved in this process, and this contributed to the characterization of Urban and Rural Landscapes. In consequence, large dormitory areas were built around the major cities. These dormitory areas around the major cities were “designed” just for providing sleeping areas. Commercial areas, kindergartens and parks, space for offices, industry and other urban facilities to create a real townscape, were limited. Now those areas are not compatible with any of the actual comfort standards [4].

Some solutions that will help to tackle this problem can be pointed out:

- local authorities must make those areas active and usable for a wide range of purposes. Establishing playgrounds, green areas, ball fields are some solutions that will improve the value of the local area,
- creating strong connections between these locations and the city centres by establishing walking, cycling and public transports connections.

5. Environmental aspects

5.1. Ventilation performance

In many of the cities in Poland huge assembly of multifamily houses were built. Elements of accompany program were designed but never built because of lack of money. So nowadays this situation should be changed. Not much attention was paid to treatment of the open areas in house's settlements. Only roads, parking space and sometimes-small playgrounds were made.

Further need should be considered: to turn the passive use of open terrains into an active one.

Thermal performance of buildings and ventilation strategies are, nowadays, some of the major problems which are observed in dwelling buildings in Poland. Until 1998, when the new thermal regulation code was published, there weren't relevant problems related to the indoor air quality: a natural ventilation of the indoor environment was guaranteed by special construction of the windows frames (special 0,8 cm louvers in the windows frames were done).

After 1998, with the increasing concerns of the energy consumption, the building's envelopes became more airtight and now there are some serious problems related to air quality in the indoor environment. The faulty ventilation is also one of the causes of moisture condensation in thermal bridges. The most problematic zones of buildings are those where moisture is produced: kitchen, laundries and toilettes. Nowadays residential buildings the natural ventilation devices are provided in toilets, bathrooms and kitchens. When new hermetic

windows are replacing the old ones we have problems with air circulation in dwelling.

The most important effects due to this problem are: inhabitant's discomfort, health problems, moisture problems and building material's degradation.

5.2. Energy performance

The application of active or passive solar measures in buildings is not a main problem for engineers that design conventional buildings in Poland. There are some examples of using this kind of strategies in Poland but now it is some kind of experiments in Poland. In the thermal regulations there are no incentives or reference to the use of passive solar measures. The only concern is related to the windows areas and respective arrangement of them. There is some information about the available solar technologies. The society is not really aware of the associated individual and global advantages of their implementation [5].

Nowadays some measures to deal with this problem are being studied such as the revision of the actual thermal regulations in order to promote the use of active and passive solar measures.

6. Architectural aspects

6.1. Functional aspects

The existing situation in large panel dwellings houses does not fulfill the demands of present-day tenants.

The functional quality of most of the multistory buildings, built between the 50's and the 80's, is one of the shortcomings of these buildings. In most cases, these buildings have an inside staircase serving two or three dwellings at each floor. Buildings with up to four floors, usually, do not have an elevator. At that time, many of the dwellings were small, with an average area between 50 to 70 m² but they met the comfort requirements of that period: one kitchen, one bath/toilet, one living room and one to three rooms and a balcony was the standard in nearly all dwellings. There wasn't a garage or an outdoor area for car parking [3].

An improvement on the economic situation of the part of the Polish families led to a change in the comfort requirements. Especially the size of the rooms and the kitchens was not up to modern standards: the introduction of use of the private car has continuously extended the need for more space. However, this is very difficult to reach in the original layout. There are some solutions that could be implemented to overcome or, at least, minimize this problem. Many of the dwellings were small. A balcony was standard in nearly all apartments but they were very small too.

Nowadays, we can see tendency to look for the ways to get more space in these small flats. Especially small balconies are not satisfied for users. Due to usable matters it is often required to enlarge dwelling area. Large-panel house usually offers small flats with specialised small usable area of rooms.

The enlarging of the flat area can be achieved in two ways, through joining the flats on the same floor or joining adjacent flats on two following levels. The development of common outdoors areas for car parking is needed. Another major functional problem of the Polish buildings is the presence of architectural barriers for handicapped persons. This is a common problem not only in the houses with flats, but also in public buildings. Nowadays, there is a legal framework about this issue, but in most cases this requirement is not fulfilled especially in dwelling buildings.

Another thing is the problem of changing first floor area in existing large slabs dwelling houses. Nowadays social needs show that we need more space for retail trade or for handicraft in neighbourhood of the flats. We can find the area for it on the first floor in existing houses.

6.2. Aesthetic aspects

In Poland, prefabricate building technologies were used in order to meet the social dwelling requirements, together with the cost reduction. The aesthetic problem of these houses was ignored.

The prefabricated building technologies were focused on the quantity rather than the quality.

Low standards of surface and equipment of flats were used. The plans of buildings were very simple. The facades were simple answer of internal configuration of the building.

Nowadays thermal renovation of these facades is completed. This action solves only thermal problems, but the problems related to construction mistakes and also to creation of the more more satisfying facades seen from an architectural point of view are still open. Improving of the inside conditions and the front elevation appearance, brings a total change to the building. It seems to be possible to exchange the outer walls with new constructions with the simultaneous change of its architecture, which enables the change of view and possibilities for buildings adaptation [8].

As most of the multi-storey buildings were constructed with load-bearing partition walls and non-bearing facades it will be rather easy to convert the former poor facades to new ones with much better architectural look.

The conclusion is that the aesthetic aspects related to the facades can be a problem, which one must solve.

7. Structural aspects

The reports related to construction failures in Polish prefabricated dwelling buildings do not mention critical situations about their structural performance. The main reason for the scarcity of accidents at this level is the application of strong safety factors on the structural design.

The most affected building elements are the external walls, cracks in the walls, compromising building's aesthetics. The cracks are also a way for water penetration which can provoke the steel bars corrosion of the structural elements of the façade and it can compromise the buildings' structural stability.

The problem arises: how to improve the quality of assemblies of element of the external walls.

8. Financial aspects

In Poland the houses' rents were almost frozen until 1989. The frozen rents were extended to the entire country, leading to the nearly total extinction of the rental market and led to some distortion in the housing market. Therefore, the owners of rented houses do not have enough income to support buildings maintenance and refurbishing [10].

This situation led to a significant decay of a large portion of the housing stock and therefore to the discomfort of its users, the creation of social ghettos and to the urban aesthetics' degradation. This situation could be observed in the roofs and façades of the major part of prefab dwelling buildings, in the cities all over the country. In order to solve this situation, after 1989, the government implemented a new renting legislation. This legislation intends to defend the interests of all interested in subject people (owners, tenants).

9. Social aspects

The main social problems – people with very limited incomes inhabit that kind of estates. These estates have a bad reputation. In near future such estates can be poor people ghettos.

In order to change the situation the general solutions might be:

- paying attention to the possibilities for improving the buildings as well as the open areas around the buildings,
- providing the tenants greater sense of responsibility for the future maintenance by involving them in the decision-making process.

10. Conclusions

The various “needs issues” were ranked in four priority groups from A to D. Each group including characteristic needs issues as follow:

Group A

- 1) neglect of climatic and environmental conditions, poor roof insulation and openings,
- 2) plentiful snowfall, long period of lying snow,
- 3) low quality of thermal insulation, low isolating material in external walls, low isolating material of roofs, asbestos, asphalt glues,
- 4) layouts based on traditional grid, shortage of housing asked for high production rate, distribution based on cranes,
- 5) type of constructional arrangements, problem for people to identify themselves with their house,
- 6) anonymity, lack of individuality and privacy, repetition of typical design elements,

Group B

- 1) lack of use of renewable energy sources,
- 2) poor condition of roof's covers, slope of roofs, bad quantity of roof's cover,
- 3) poor condition of roof's thermal isolation, bad quality of thermal isolation, not sufficient layer of roof's thermal isolation,
- 4) poor condition of envelopes covers, bad quality of envelopes cover,
- 5) poor condition of envelopes thermal isolation, bad quantity of thermal isolation, not sufficient layer of envelopes thermal isolation,
- 6) guideline norm of flat design, lack of diversity in housing complex, building inaccessible for elderly and handicapped people, too small rooms in flats, kitchen without windows in flats of '60,
- 7) monotonous arrangement of settlements, loss of man's scale,
- 8) monotony of large teams of house, too large housing estates,
- 9) users are not able to use full programs of settlement's services, poor quality of semi-public urban areas,

Group C

- 1) incorrect connection between settlement and the rest of city,
- 2) too large spaces between buildings, loss of man's scale, small surface for recreation function, small parking area,
- 3) neglect of climatic and environmental conditions,
- 4) monotonous aesthetical view of buildings and group of buildings,
- 5) lack of social relations among the users of the buildings,
- 6) selling of rented apartments to tenants, low involvement of tenants with management of settlements,

- 7) town planning, financial problem, lack of possibilities of supplements, functional programs, changes in settlement because of financial problems,

Group D

- 1) degradation of concrete, reinforce elements too close to surface of elements,
- 2) low quality of acoustic, insulation inside and outside of the building.

One can registered that the most important need issues (see group A), were classified as follows:

- a) to thin thermal isolation and check the general energy performance of the buildings,
- b) to repair the strength of construction of the buildings (snow and snowfall),
- c) to exchange of installation while fundamental repairs of the buildings are going,
- d) to improve indoor climate and indoor environmental conditions,
- e) to remove asbestos and asphalt glues, while fundamental repairs of the building is going,
- f) problem of anonymous group of the buildings,
- g) new arrangement of public and semi-public areas.

To meet the needs one must change:

- 1) building law and codes in Poland,
- 2) improve financial environment of the buildings in Poland,
- 3) improve method of control of safety procedure for periodical and major repair of the buildings in Poland,
- 4) improve thermal isolation and check the general energy performance of the buildings in Poland,
- 5) improve mentality of the users, managers and designers, who are participants of the building process.

A lot of the building stock was built before the publication of the new thermal regulation, therefore with small thermal insulation; its thermal performance is inadequate in almost all those cases. In spite of this reality, the thermal rehabilitation is now a common practice all over Poland. The thermal insulation is still a big-scale problem that must be solved, but it is not the only one problem. There are some more problems, which were characterized above.

If some or all of the problems related to the buildings, could be reduced, solved or eliminated, then not only building envelopes would be better, but whole building would be more functional and economical. There is no doubt that residents would be much more satisfied but the implementation of it requires a long-term vision.

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PROBLEMY ELEWACJI BUDYNKÓW WIELKOPLYTOWYCH

Streszczenie

W artykule podano przegląd typów domów wielkopłytowych w Polsce, przedstawiając główne problemy i potrzeby zidentyfikowane w elewacjach miejskich budynków wielorodzinnych. Faktyczne potrzeby modernizacji wielkopłytowych budynków zostały przedstawione, biorąc pod uwagę strukturalne, cieplne i estetyczne aspekty. Model poprawy takich budynków w Polsce został przedyskutowany i zilustrowany przykładami. Możliwości dalszej poprawy sytuacji również zostały przeanalizowane.

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