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# THE LEVEL OF SEISMIC RESISTANCE OF RESIDENTIAL BUILDINGS IN ARCHITECTURE

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**Abstract**

The article deals with the main problems of ensuring the seismic resistance of buildings with walls made of large blocks of sawn limestone, as well as the issues of moral and physical wear and tear of residential buildings, and extension of the service life. The possibility of applying the main methods for the reconstruction of block buildings with an increase in the number of stories, the prospects for implementation are considered. A technical and economic comparison of different options for increasing the number of stories is presented.

**Keywords:** reconstruction, reconstruction methods, modernization, seismic resistance, five-story block buildings, housing stock, architecture

Reconstruction of the housing stock of Uzbekistan, taking into account the level of seismic resistance of residential buildings, in the near future will be one of the priority tasks of a strategic state nature. The problems of operation of residential buildings of typical mass series are aggravated every year. In the 60s, these houses were built with the dominant idea to reduce the acute shortage of housing stock in the country in the post-war period. Today, non-fulfillment of planned major repairs and modernization of such buildings leads to a decrease in the safety of their operation and an increase in the risk of accidents. In Uzbekistan, almost every third residential building requires reconstruction, and these are the so-called barracks houses or houses in the form of communal apartments. The existing practice of their maintenance leads to premature wear of individual elements of buildings and engineering systems. Therefore, research and search for effective solutions for the reconstruction of such buildings are relevant.

The introduction of new norms into the number of seismically hazardous areas included more than 120 thousand km2, which is about 20% of the territory of Uzbekistan. In previously earthquake-prone areas, the calculated intensity has been increased.

Modern urbanized Uzbekistan is becoming more and more vulnerable to strong earthquakes due to the growth of population density, the complexity of urban infrastructure, the deterioration of the engineering and geological properties of soils, including the rise in the level of groundwater over the past 50-60 years. In these territories there is a large number of housing stock, a special group of which are 4-5-storey block houses of mass series built in the 50s - 80s, which were designed and built without taking into account seismicity, or according to underestimated, in comparison with the current requirements for seismic resistance.

Methods for the reconstruction of residential buildings have been sufficiently studied and varied. Options for architectural and planning reorganization include: preservation of the building without changing its volume and composition, but with redevelopment of the premises; preservation of the building and its functions with redevelopment and its inclusion again in the building complex being formed; preservation of the building as an independent object, but with the obligatory expansion or superstructure, or demolition of the building.

Methods for the reconstruction of the old housing stock - ensuring the seismic resistance of reconstructed buildings is a complex multi-criteria technical task that requires new approaches to its solution.

The purpose of the ongoing research is a technical and economic analysis of methods for the reconstruction of large-block buildings with the provision of acceptable risks in terms of reliability under changing seismic hazard.

In connection with this goal, the following tasks are solved:

- consideration of the problems of reconstruction of residential five-story buildings;
- assessment of existing methods for the reconstruction of mass buildings;
- comparative analysis of options according to technical and economic indicators.

**Results and their analysis**

Comprehensive reconstruction of the housing stock is possible in the following areas:

- ✓ installation of superstructures and attics;
- ✓ installation of a superstructure on a platform above a residential building;
- ✓ the use of secondary development, increasing the width and height of the house;
- ✓ conducting parallel construction next to five-story buildings.

The superstructure of buildings can be carried out both without strengthening the structures of the existing building, and with reinforcement (perhaps even with a device for the superstructure of an independent foundation, independent of the existing one). Experimental design shows that existing five-story buildings can be built on 2-3 floors, as a rule, without strengthening the foundations, but with strengthening the walls of the first floor. Most often, the superstructure is carried out without the resettlement of residents.

The implementation of superstructures based on an independent frame makes it possible to increase the height of buildings up to 12 floors.

Thus, three types of add-ons are possible:

1) arrangement of attics, i.e. the location of the premises in the under-roof space, in place of the converted attic;

2) the superstructure of the building itself, i.e. construction of several more floors on existing ones using measures to strengthen existing structures (reinforced concrete pylons along the outer contour of the building);

3) the device of the outer frame, consisting of "balcony stacks" along long facades and powerful transverse beams resting on them, carrying the superstructure (the "Flamingo" method, is performed in metal structures). The implementation of superstructures based on an independent frame makes it possible to increase the height of buildings up to 12 floors.

Options for the arrangement of two-story attic rooms are shown in fig. 1. The area of the upper level turns out to be very small and only sleeping quarters are placed here. When using two-level attics, the problem arises of placing intra-apartment stairs, which are not only a communicative tool, but also a very important factor in solving (decorating) the interior.

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**Fig. 1. One of G. Atterbury's experimental concrete houses in Sewaren, N.J. Photo by Standardized Housing Corporation / The Manufacture of Standardized Houses**

The load-bearing structures of attics are usually made of metal or wood with the inclusion of metal structural elements. Usually this is an independent frame truss strut system. If the attic is two-level, then the inter-level beams serve as puffs of the truss system, reducing the free length of the racks and rafter legs.

Fig. 2. Mansard device options: A - using the upper technical floor or with the transformation of the existing upper floor into a daytime zone and placing the sleeping area in the under-roof space; B - attic device with a superstructure of one floor; B - placement of two-story premises under a high roof.

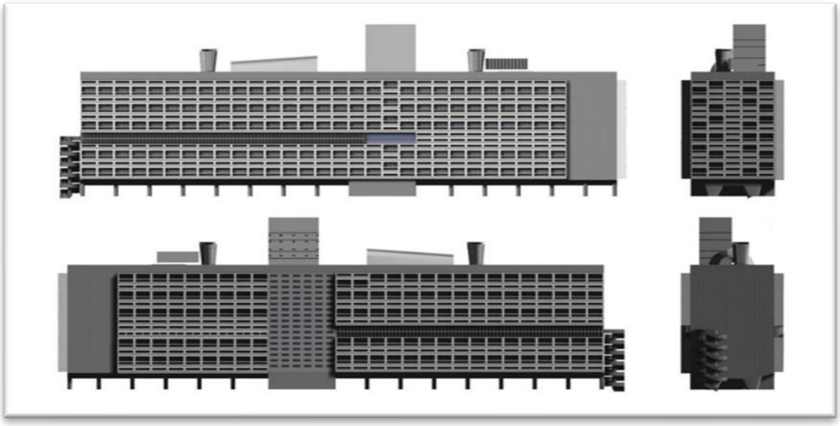

***Fig. 2. The Marseille residential unit (Unité d'Habitation) is a seventeen-story single complex in Marseille (1945–1952) located in the middle of a park on Boulevard Michelet***

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On fig. 2 shows various schemes of add-ons that allow you to increase the height of the building by several floors at once. According to scheme A (Fig. 4, A), the superstructure is carried out without changing the structural and planning scheme and significant strengthening of the bearing elements. Basically, the reserves of strength of the base, walls and foundations are used, therefore, when redevelopment, the walls (or frame) of the building are not affected.

According to scheme B, only part of the load from the superstructure is transferred to the existing structures. The main part of the additional load will be transferred to the newly erected load-bearing elements, the floor layout during the reconstruction is linked to the old vertical load-bearing elements and the newly erected frame columns inside the building contour, based on their own foundations. The described scheme of the superstructure is structurally complex, but rational when it is necessary to noticeably change the number of storeys of the building.

According to scheme B ("Flamingo" scheme, Fig. 2, B), columns are installed along the contour of the building, based on independent foundations. Balconies or loggias are arranged between the columns and walls of the existing building, increasing the width of the building. Structurally, the superstructure is a combination of external columns and single-span beam-walls, combining the functions of partitions and load-bearing structures.

Rice. 2. Structural schemes of multi-storey superstructures: A - with load transfer to existing structures without changing the structural scheme of the building; B - with the transfer of only part of the load to existing structures and with the installation of additional frame columns; B – from transverse beams-walls and external columns carrying the superstructure ("Flamingo" scheme); 1 - built-on building; 2 - add-on (highlighted by filling with color); 3 - columns of the new frame, installed according to the new design and planning scheme (shown in dotted lines); 4 - columns carrying only the superstructure (shown in dotted lines); 5 - beam-walls (shown with a textured fill) Extensions to buildings and built-ins are carried out in cases where it is necessary to eliminate the gap between buildings or increase the width of the body. Most often, a new volume added to an existing building in the process of building reconstruction is attached to the end or side. Embeddings are also used in cases of architectural unification of buildings.

Structurally, extensions are considered as objects of new construction. And only in places where new volumes adjoin existing ones, it is necessary to carry out a set of special constructive measures, primarily related to the potential for the manifestation of sedimentary deformations. In the foundations of old buildings, the soil has consolidated during operation, and the foundation under the new building will be compacted for a sufficiently long period, depending on the magnitude and nature of the load. Therefore, the adjunction of a new building to existing ones should be carried out with the obligatory installation of sedimentary seams, which ensure unhindered vertical displacement of an extension or extension relative to the existing building.

Thus, when constructing high-rise buildings, it is necessary to take into account the level of seismic resistance of residential buildings in architecture. it follows that:

1. The technical condition of many large-block buildings allows them to be reconstructed with a superstructure. Inspection of such buildings, as a rule, reveals the reserves of the bearing capacity of the foundation soils, foundations and walls of residential buildings.
2. An increase in the level of groundwater, territories of urban agglomerations with mass buildings of the second half of the last century, leads to an increase in the risk of destruction during seismic impact.
3. Reconstruction with a superstructure of residential buildings with walls made of large blocks and the implementation of the additional living space obtained is practically the only real way to finance not only the overhaul of roofs and engineering networks, but also an increase in the seismic resistance of such buildings.
4. A feasibility study revealed that the effective number of floors to be built on when constructing reinforced concrete pylons on their own foundations is at least three. The construction of mansards in lightweight structures at a relatively low total cost is generally less efficient, and is unlikely to create financial prerequisites for the implementation of constructive measures to improve the seismic resistance of the building.

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