Some aspects of the organization of the processes of renovation of the housing stock in Irkutsk

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Abstract. It is rather complicated to use a renovation method based on removing old buildings and constructing new ones. As a rule, the method requires huge regional funding. For this reason, an alternative method is needed. It can be based on the old buildings’ fund reconstruction. This way some old buildings could be transformed into the high-quality residential complexes that would provide everything for comfortable living. When choosing a particular method, it is necessary to consider a lot of factors. The factors have to be structured according to houses’ condition analysis. The basis of this analysis is microdynamics research including a high-precision laser vibration measuring system. The presented method could help to determine a construction condition of an object and to develop a proper renovation campaign. The article represents the analysis of a renovation program of the housing stock in Moscow, Russia. It also proves the uselessness of massive usage of the referenced program all over Russian regions. The reason for this is specific local characteristics that every region has. The first housing stock renovation phase was developed on the example of Irkutsk city, Russia. This program allows estimating beneficial economic decisions that would help to improve the architectural appearance of the city and the quality of the housing stock.

Dynamical processes in the housing sector require appropriate modification in housing policy. When the amount of the housing building rises and improves, the question of saving housing funds is extremely important. Moreover, the efficiency of houses’ exploitation and living comfort should not be ignored. A lot of countries have to face with the urgent necessity of postwar building fund renovation that has expended its technical, economical, and exploitation resources. In former socialist European countries, 40% of people live in a mass housing development while in Western European countries it is 10% of people. In Russia, 60% of the big cities’ housing fund are houses that were built in 1956-1990. According to experts’ estimates, up to 50% of the big cities’ housing fund includes panel buildings, block and brick houses that are built from standard projects of 1950-1970 [1]. Regardless of a particular location, every regional housing stock in the world has the same problems such as:

1. The territories were built up from the same plan with the financial support of the government or private subsidies.

2. Districts and their parts were built up in a short time. All the buildings are the same age. Hence, they get older in the same way, which causes a lot of financial resources for renovation at the same time.
3. The majority of postwar residential complexes were built in modernism style that includes straight lines, huge open spaces, contrast colors, and a big amount of concrete.

4. Technical standards and building materials of previous years do not comply with modern energy efficiency standards, waterproofing, and sound insulation.

5. The floor plans and exterior finish have become outdated.

Except for all the mentioned issues, the violation of capital repair’s terms makes the situation much worse. As a result, the construction system loses its strength more quickly.

Nevertheless, it is important to remember some benefits that mass housing development possesses. They could be useful in the future. A goal to develop affordable houses in 10 years is set in Russia on a federal level. At this point, it is important to realize that mass housing development is one of the keys to achieving the goal [2]. The Soviet Unions’ houses in the cities may help to solve a housing problem that many families with limited sources have. Furthermore, the flats are compact, which causes a lower cost of housing services. The fact that all these houses are built from similar projects might contribute to realizing rather affordable modernization projects. Standard housing projects with their tiny flats and small windows possess a great energy efficiency capacity. For instance, in panel houses, it could be possible to reduce primary thermal energy by 40-50% through renovating and heating the engineering system.

Therefore, the housing fund modernization in a particular city is more complex, than replacing old housing funds with new residential skyscrapers. Thus, the modernization of the whole housing fund should be the goal of the renovation. This procedure includes conformity with modern standards and an essential integration of districts into the urban space. It is also important to save districts’ local identity.

The experience of panel house renovation in Russia for the first time appeared in Moscow city. The present housing fund of Moscow composes 243, 6 million square kilometers as of 1\textsuperscript{st} January 2019. A major part of the housing fund was built in the industrial house building period that had been commenced with a Moscow city reconstruction in 1951-1960. The renovation of the housing fund in Moscow consists of many events that are to upgrade a built environment and to create beneficial living conditions. This process creates a well-maintained public space and prevents the growth of invalid housing funds in the city. The program is applied till 2032 [3,4]. It would help to reduce the misbalanced urban space development of the last dozens of years in Moscow. In the renovation program, the following categories of houses were included: apartment blocks of the first industrial house building period and constructively identical apartment blocks. All inhabitants in these apartment blocks including owners of apartments supported the idea of involving these houses in the renovation program.

At the end of 2020 the law on complex territory development was signed in Russian Federation. It is also known as the all-Russian renovation. The main idea of the law is a creation of a unified complex development mechanism including removing invalid houses from the Moscow city renovation program experience. However, it is inappropriate to use the Moscow program all over Russia. Firstly, Moscow city renovation is supported by a government budget that grants more than a hundred million rubles. At the same time, regions do not possess even a part of this amount of money for this purpose as the majority of regional budgets are in deficit.

Secondly, the Moscow city renovation coordinator and customer is the Moscow government, while regional projects are expected to be realized by private development companies. Nevertheless, developers are not ready to start such projects as there is no detailed information about them.

Another problem is that the renovation in the capital bases on a big difference between the cost price of a building and the selling price. That cannot be realized in the regions, where this difference is way smaller.

Thus, the factors of successful renovation in the capital are the huge city budget, high realty prices, and steady demand. But this kind of renovation cannot be used properly in the regions with their specific features, it will not be able to solve invalid houses’ problem. Nevertheless, another solution might be useful to improve the functional and layout organization of old buildings. The capital repair could make urban space more comfortable and save the budget.
Thereby, some support tools have to be created, that would consider regional features, stimulate improvements and prevent negative tendency. Technical condition data, population level, and its social situation, as well as the relevance of the fund, should be analyzed in the first place. According to the information, territorial problems should be discussed at both federal and local levels. This article represents a review of this principle in Irkutsk city.

In the 1960-s Irkutsk region was extensively built up with residential large-panel houses including different constructive schemes in them. To make the building process fast and extensive, large-panel building technology and standard projects were involved. This category included houses with internal and complete frameworks of a 1-335 building series [5]. External single-layer panels, which were made of gas-ash concrete, work as self-supported and load-bearing walls.

Large-panel houses’ standard projects of 1-335C and 1-335AC were developed by the Leningrad zonal research project institute of experimental engineering for regions with the seismic activity levels of 7 and 8 scores. They were operational between 1959 and 1970, but were used in the Irkutsk building process in 1960-1976 [6]. Nowadays it is more than 400 houses of these building series or their analogs. These buildings also compose a huge amount of housing fund in cities such as Zima, Ysolye-Sibirskeye, Shelekhov, Angarsk, and others [7,8]. Houses of 335 building series have been exploiting for about 37 to 50 years with no repair and protection measures. They have some typical defects such as detachment of external textured layer, panel separation through the external reinforcing fabric, and some local fractures on a window sill, field weld, and monolithic isolation joint.

The analysis of the outdoor environment enabled to highlight the main factors that predetermine the need in the integration of the renovation program:

- A big amount of housing fund in the Irkutsk region consists of the houses of 335 building series;
- The location of these houses is in extremely different geotechnical conditions;
- The houses are out of project exploitation period [9];
- Random microdynamic tests of technical houses’ condition of the building series have snowed unsatisfying results [10].
- The buildings have to keep functioning due to social and economic regional conditions.

Therefore, rapid instrumental estimation of general houses condition should be made. This way, a diversification by seismic deficit could be explained. All the tests are done distantly with no inconvenience for inhabitants using modern equipment.

To find the ability to continue the exploitation, to remove a building gradually with minimum risks it is reasonable to assess the building conditions by doing microdynamic researches with a high-precision laser vibration measuring system.

Table 1. List of measures of the program for the renovation of the housing stock.

| Phase | The goal of the phase | Planned measures and execution methods | The planned amount of works | Timeframe |
|-------|-----------------------|----------------------------------------|-----------------------------|-----------|
| 1     | Development and explaining of regional seismic passportizatio n of 335 building series residential houses | 1.1. Random microdynamic tests of houses in mass housing developments of different districts 1.2. Precise houses’ research in every plot with defects and materials’ quality fixation 1.3. Finding correlations between dynamic houses’ parameters and their defects | At least 5-7 houses should be located on every building plot. Total: 60-80 houses At least 2 houses on the plot. Total: 60-80 houses It is possible to generalize statistics from paragraphs 1.1 and 1.2, | 1,5 months for each plot. Total: 15-17 months 1 month for each house. Total: 10-12 months 2 months |
Suggested work sequence is the only way to find a solution when a schedule is extremely tight due to probable accident-free exploitation period of the houses that in reality has been exhausted for a long time ago [11]. After completion of all the mentioned works, the next step should be done. It may be realized in two directions.

The first one consists of completing repair and modernization works. They include dismantling of defective materials and improving energy and heat residential house protection. Large-panel houses modernization may include the following works:

- Heating modernization of outer walls and shingle roofs;
- Front modernization including aesthetic improvements;
- Staircase and window frame substitution for energy-efficient elements;
- Repair measures of balconies’ and loggias’ defects [12];
- Sanitary engineering and gas and heat installation replacement;
- Mechanical and natural ventilation replacement;
- Front door replacement and entrance reconstruction;
- Building of new parking spaces;
- Greening measures of house territory.

Another approach is more intensive and expensive. It includes:

- Reconstruction with house’s shape and dimensions correction adding new elements;
- Fronts transformation (window frames replacement, balconies and winter gardens adding);
- Roof transformation to add extra housing space [13];
- Entrance, staircase, elevators, and flats reconstruction for the purpose of their adapting for persons with a disability;
- Heating systems with renewable energy sources integration.

By realizing all mentioned measures one of the tasks of the government program would be done. The program “Provision of affordable and comfortable housing and public utilities for Russian Federation’s citizens” was approved by resolution of Russian Federation Government from 15 April 2014 №323 “On
approval of government Russian Federation program “Provision of affordable and comfortable housing and public utilities for Russian Federation’s citizens” [14,15]. The reconstruction program improves the affordable housing system and quality and reliability of housing and communal services provision, creates comfortable urban space.

Realization of renovation programs can be effective in many ways such as social, urban, economic, and macroeconomic levels. Moscow city renovation experience should be adapted for other regions at the moment. The program should include technical house’s condition estimation that results in forming of processes and measures of a particular residential house.

References
[1] Panova V F 2003 Development of decorative slag cement Modern construction materials and resource-saving technologies p 168
[2] Lot B A and Mitina H A 2000 Orming of optimal porous gas concrete string of non-autoclave hardening Eq. higher education institutions. Chemistry and Chemical Technology 43 (3) pp 118-119
[3] Rzhansitsyn A R 1971 Determination of the safety factor for time-varying random loads and strength Reliability problems in structural mechanics pp 3-9
[4] Maizel I V and Bober V A 2020 Intensification of water supply and sanitation systems in the city of Nizhneudinsk. Proceedings of Universities. Investment. Construction. Real estate 10(4) pp 578–587
[5] Kalashnikov M P 2020 Study of the air environment state in the building for the storage of perishable products Proceedings of Universities. Investment. Construction. Real estate 10(2) pp 206–211
[6] Krylov V V, Gladkov V S and Ivanov F M 1972 On the assessment of the stress state and destruction of concrete during freezing Concrete and reinforced concrete 8 pp 39-41
[7] Laukaitis A A 2004 Study of influence of additives of ground wastes of cellular concrete on its properties Construction materials 3 p 33
[8] Ravakumov E G 2001 Soft Mechanochemical Synthesis a Basis for New Chemical Synthesis a Basis for New Chemical Technologies p 216
[9] Zhigulina A 2012 Building Envelopes: An Objective Measure of Comfort in Residential Buildings Urban Planning 1 pp 80-81
[10] Korenkova S 2000 Filled Foam Concretes in Building Envelope Construction Building Materials 8 pp 12-14
[11] Tarasova A G, Alalykin A A and Vesnin E S 2017 New heat-insulating materials based on inorganic binder 4
[12] Sobolev V I and Chernigovskaya T N 2020 Research into the dynamics of radio telescope foundations using laser vibration measuring equipment Proceedings of Universities. Investment. Construction. Real estate 10(3) pp 420–427
[13] Komarov A K, Ivanov I A and Lundenbazar B 2019 Theory and practice of the use of gabions for forming protective structures Proceedings of Universities. Investment. Construction. Real estate 9(1) pp 78–89 DOI: 10.21285/2227-2917-2019-1-78-89
[14] Melnikov D A and Dmitrieva T L 2020 Validation of the load-bearing capacity of the frame assembly of metal structures on the standard 2.440 series using IDEA StatiC Proceedings of Universities. Investment. Construction. Real estate 10(3) pp 406–419
[15] Shalaginya N A Patent for utility model RU 86613, 10.09.2009. Denunciations No. 2009116591/22 of 30.04.2009