Technical condition of apartment buildings in the central regions of Russia

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Abstract. The article notes the presence in Russian cities housing stock of the central regions of a large number of residential apartment buildings, built over 50 years ago and in operation. The bearing capacity of the structures of these houses has significantly decreased. In connection with this carried out a survey of technical condition of houses. For buildings that are for further operation invalid state, the procedure of recognition of their emergency. Analysis of data on the technical condition of apartment buildings showed that in the cities of Kazan, Samara and Volgograd, the physical deterioration of residential buildings is 25-28%, which is less than the average value in Russia, and in Nizhny Novgorod it is significantly higher and amounts to 38%. The data allow us to conclude that in the near future in Nizhny Novgorod one should expect a large number of residential buildings to go into emergency condition. Analysis of indicators of the state of emergency residential buildings in these cities shows that the percentage of the city of Samara operated homes, referred in 2013 to the state of emergency, the largest and is 10.1%, which is significantly higher than the average value in Russia. As one of the main reasons for the incomplete resettlement of emergency houses under the program for the period 2013-2018 indicates "the unknown whereabouts of the owner." The article concludes that it is possible to increase the efficiency of the resettlement program through operational work with the owners of residential premises of liquidated residential buildings.

1. Introduction
Currently, in the Russian Federation operates a large number of residential apartment buildings, built over 50 years ago. The main supporting structures of such buildings during the period of operation were subjected to various loads, including numerous dynamic effects and the influence of negative environmental factors [1, 2]. As a result of prolonged operation houses bearing capacity of structures could be significantly reduced [3, 4]. In connection with this very relevant is a thorough examination of the technical condition of apartment buildings, as well as the development of organizational and technical measures for the overhaul [5,7].

Events should provide a minimum negative impact on the environment [8, 9], and to objects having historic or architectural importance - the possibility of using an alternative design of retaining elements [10, 11]. For buildings that are inadmissible for further operation, it is necessary to apply the procedure for recognizing them as emergency and relocate residents. At the same time, it is important to timely prepare the resettlement housing stock for residents of houses that are subject to repair, reconstruction or demolition.
2. Materials and Methods
The generalized data on the technical condition of apartment buildings are analyzed using open statistical sources for large cities in the central regions of the Russian Federation. In particular, we consider the data about the state of residential buildings megacities located on the great Russian river Volga Nizhniy Novgorod, Kazan, Samara and Volgograd.

The technical condition of buildings is determined based on the results of their survey [12]. The main regulatory documents defining the procedure and composition of building inspections in Russia are: SP 13-102-2003 Code of rules for design and construction: rules for examining load-bearing building structures of buildings and structures and GOST 31937-2011 Interstate standard: Buildings and constructions. Rules of inspection and monitoring of the technical condition.

These documents determined that the buildings and structures can be operated, if they are on the results of state structures estimates are in the regulatory technical or operational. But if the physical deterioration of home designs exceeds 40%, and they are characterized by injuries and strains, confirming the exhaustion of their load-bearing capacity, the residential building should be evaluated for its reference to a crash.

3. Results
In Russia as a whole, the average value of the physical wear and tear of apartment buildings, information about which is placed in the information system [13], is currently 32%. In this case, the largest of the exploited wear homes (about 55%) have the buildings built in the period 1920-1940. For information about the serviceability of houses show that the average number of homes in the country, are in poor condition is 3.1%. At the same time, buildings of earlier construction correspond to a greater percentage of houses in emergency condition (table 1).

| Period of putting residential buildings into operation | Average percentage of depreciation of residential buildings, % | Share of apartment buildings in emergency condition, % |
|--------------------------------------------------------|---------------------------------------------------------------|--------------------------------------------------------|
| 1920-1930                                              | 55.9                                                          | 11.9                                                   |
| 1931-1941                                              | 55.0                                                          | 13.5                                                   |
| 1942-1952                                              | 49.2                                                          | 7.1                                                    |
| 1953-1963                                              | 43.4                                                          | 5.0                                                    |
| 1964-1974                                              | 36.6                                                          | 1.9                                                    |
| 1975-1985                                              | 29.8                                                          | 1.4                                                    |
| 1986-1996                                              | 23.2                                                          | 1.1                                                    |
| 1997-2007                                              | 13.7                                                          | 0.3                                                    |
| 2008-2018                                              | 3.8                                                           | 0.1                                                    |
| 2019-2020                                              | 1.1                                                           | 0.0                                                    |

To the largest cities in the central regions of Russia analysed parameters are shown in table 2. Of these, it follows that the average percentage of deterioration of residential apartment buildings in Kazan, Samara and Volgograd are practically equal at 25-28%, and in Nizhny Novgorod - is much higher: 38%. From this we can conclude that in the coming years in Nizhny Novgorod one should expect a significant increase in residential buildings that have passed into the status of emergency.

Comparison of indicators of the emergency state of residential buildings in the cities under consideration shows that at the moment in Kazan there are no residential buildings in the number of operated houses that were classified in emergency condition in 2013 (with the exception of one house).
However, in Samara, the percentage of such residential buildings is the largest and is 10.1%, which is significantly higher than the average value in Russia (3.1%).

**Table 2.** Information on the technical condition of apartment buildings in the largest cities in the central regions of Russia [13].

| City name | Average percentage of depreciation of residential buildings, % | Share of apartment buildings in emergency condition, % |
|-----------|----------------------------------------------------------------|------------------------------------------------------|
| Nizhny Novgorod | 38.0 | 5.1 |
| Kazan | 25.4 | 0.0 |
| Samara | 28.3 | 10.1 |
| Volgograd | 25.4 | 8.4 |

To analyse the reasons for these significant differences, refer to table 3. It provides information about the resettlement of citizens during the period of municipal programs for the resettlement of citizens from emergency housing in the period from 2013 to 2017. Residential buildings were recognized as damaged as of January 1, 2013. The table shows that the total housing stock in Kazan and Samara is practically the same, while the number of homes resettled in Samara twice more than in Kazan. Thus, during the period under review, a large number of one- and two-apartment houses built in 1920-1930 were subject to resettlement in Samara. Figure 1 and having relatively small living space. In such homes uncomfortable and would be dangerous. It is obvious that many people temporarily moved to live to their close relatives. It is no coincidence that one of the main reasons for the incomplete resettlement of damaged houses of that period indicated: "the unknown whereabouts of the owner".

**Table 3.** Information on the resettlement of emergency housing stock in cities in the period 2013-2017 [14].

| Indicator | Nizhny Novgorod | Kazan | Samara | Volgograd |
|-----------|----------------|-------|--------|-----------|
| Population, thousand people | 1250 | 1250 | 1150 | 1010 |
| Housing stock, thousand sq. m | 38038 | 34632 | 34205 | 23008 |
| Number of housing houses | 10741 | 6300 | 12305 | 6374 |
| Number of resettled houses | 34 | 89 | 209 | 33 |
| The area of the settled houses, sq. m | 6200 | 50400 | 45500 | 12200 |
| Average area of settled houses, sq. m | 182 | 566 | 217 | 370 |
| Number of incompletely settled houses | no data | 1 | 111 | 11 |
| Reasons for incomplete resettlement | - | Unforeseen circumstances (litigation, acceptance of inheritance, unknown whereabouts and other circumstances related to the personality of a citizen) |

The analysis of indicators of the technical condition of apartment buildings in the cities of the Samara region is carried out. At the moment, the average value of wear of houses varies in a small range (table 4). The exception is the city Pokhvistnevo data, wherein the analysed value is minimal and amounts to 13.5%, and the city gratifying for which the wear rate and the maximum is 39.0%.
The relative number of apartment buildings in emergency condition in 2013 was recorded: the largest - in Syzran (19.9%), and the smallest - in Togliatti (only 0.1%). These Togliatti can be explained by the fact that the city is relatively young and active construction of residential apartment buildings in it began to develop only in the 70-ies of the last century due to the erection and commissioning of the Kuibyshev hydroelectric operation, enterprises of the chemical industry and the Togliatti automobile plant.

Table 4. Information about the technical condition of apartment buildings in the cities of the Samara region [13].

| City name         | Average percentage of depreciation of houses, % | Share of apartment buildings in emergency condition, % |
|-------------------|-----------------------------------------------|--------------------------------------------------------|
| Zhigulevsk        | 28.7                                          | 10.9                                                   |
| Kinel             | 27.3                                          | 12.9                                                   |
| Novokuibyshevsk   | 34.3                                          | 6.1                                                    |
| Oktyabrsk         | 21.2                                          | 11.0                                                   |
| Otradnyy          | 39.0                                          | 8.5                                                    |
| Pokhvistnevo      | 13.5                                          | 8.7                                                    |
| Samara            | 28.3                                          | 10.1                                                   |
| Sizran            | 30.3                                          | 19.9                                                   |
| Tolyatti          | 27.8                                          | 0.1                                                    |
| Chapaevsk         | 29.4                                          | 15.0                                                   |

In the cities of the Samara region, the total number of houses for which the resettlement was not fully completed was 127. Most of them (excluding Samara) are in the city of Zhigulevsk (table 5).

Thus, a large percentage of emergency residential buildings in Samara to date can be attributed to a lot of dilapidated housing, as well as the result of incomplete implementation of the municipal programs of the previous period and the incomplete settling emergency apartment houses due to "unforeseen circumstances." In order to minimize such “unforeseen circumstances”, it is necessary to begin organizational work to identify the whereabouts of the owners at the initial stage of the resettlement program.

In 2019, a new stage of liquidation of hazardous housing began. As part of the federal objectives of the project "Sustainable reductions unsuitable for housing accommodation", which is part of the national project "Housing and the urban environment", developed and adopted by the regional program of resettlement of citizens unfit for housing accommodation in the 2019-2025 years. The main objectives of the programs and the planned results are shown in table 6.
Table 5. Information on resettlement from emergency residential apartment buildings in the cities of the Samara region [13].

| City name          | Number of houses for which resettlement has been completed | Total area of settled houses, sq. (m) | Number of houses for which resettlement has not been completed |
|--------------------|------------------------------------------------------------|---------------------------------------|---------------------------------------------------------------|
| Zhigulevsk         | 116                                                        | 47950                                 | 8                                                             |
| Kinel              | 2                                                          | 1320                                  | 0                                                             |
| Novokuibyshevsk    | 39                                                         | 16990                                 | 0                                                             |
| Oktyabrsk          | 38                                                         | 6980                                  | 1                                                             |
| Otradnyy           | 49                                                         | 18850                                 | 0                                                             |
| Pokhvistnevo       | 58                                                         | 19180                                 | 0                                                             |
| Samara             | 209                                                        | 45530                                 | 111                                                           |
| Sizran             | 94                                                         | 34300                                 | 0                                                             |
| Tolyatti           | 0                                                          | no data                               | no data                                                       |
| Chapaevsk          | 32                                                         | 21910                                 | 0                                                             |

The new stage of the program is based on the assessment of the technical condition of apartment buildings, carried out in 2015-2016, and provides for the resettlement of citizens from the housing, a recognized emergency on January 1, 2017. As the table shows, the least amount of emergency housing after the first stage of resettlement (2013-2018.) to be relocated in Kazan: just 51 houses with total area of 15946 square m. It is planned to settle an order of magnitude more houses in the city of Samara. This situation is quite natural, since it follows from the general situation regarding the presence of residential apartment buildings in an emergency condition (tables 2 and 6).

Table 6. Key indicators of regional programs for resettlement of citizens from hazardous housing in the period 2019-2025 [13].

| Indicator                                           | Nizhny Novgorod | Kazan | Samara | Volgograd |
|-----------------------------------------------------|-----------------|-------|--------|-----------|
| Number of emergency houses in the constituent entity of the Russian Federation included in the programs 2019-2025 | 1559            | 164   | 1304   | 629       |
| Settlement area of residential premises in the constituent entity of the Russian Federation, sq. m | 901             | 85    | 1168   | 319       |
| Number of houses to be resettled in the city       | 26930           | 15946 | 392650 | 171440    |
| The area of residential buildings to be resettled, sq. m | 192             | 51    | 500    | 253       |
| Number of resettled citizens, people               | 63206           | 15946 | 155160 | 146416    |
| Average area of houses to be settled, sq. m         | 4900            | 1449  | 11710  | 9806      |
| Average area of living quarters per person, sq. m   | 329             | 312   | 310    | 578       |
| The proportion of the area resettled homes of the urban housing stock,% | 12.9            | 11.0  | 11.2   | 14.9      |

The indicators characterizing the share of the areas of houses being settled in the total urban housing stock differ significantly for the cities under consideration. The average value of the indicator is 0.29%. The indicator is clearly insufficient for the megacities of the Volga region. Obvious need to take steps
to improve this integral index of at least three times. Otherwise, the number of accidental dwelling houses in the cities will not be reduced and continue to increase.

Conclusions
1. The experience in the development and implementation of federal and regional programs for the resettlement of citizens from emergency residential apartment buildings has shown their high need and prospects.

2. In order to prevent the incomplete implementation of the resettlement progress of resettlement programs and the elimination of emergency apartment houses due to "unforeseen circumstances," local authorities is recommended to start organizing work on identifying the seat of the owners at an early stage of implementation of the resettlement program.

3. To further increase the efficiency of emergency housing liquidation programs and achieve a stable dynamics of a decrease in the housing stock of million-plus cities in the central regions of Russia, related to an emergency state, it is necessary to significantly increase the volume of resettlement both in the number of apartment buildings and in their total living space.

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