

Analysis of the factors influencing prolongation of inter-repair terms of capital repairs of the apartment house

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Abstract. In modern conditions, the most important method of ensuring the safety of the housing stock and improving the living conditions of the population is capital repairs, as a form of simple reproduction of the housing stock, inextricably interrelated with the process of expanded reproduction (construction, reconstruction and modernization). However, at the present time, despite the long, protracted process of reforming the housing and communal sector and a number of significant transformations and changes, the housing problem remains still unresolved. At the same time, it is impossible not to recognize the fact that the unsatisfactory state of the housing stock significantly reduces the level of socio-economic development of our country and the comfort of living of citizens. The article identifies the main factors that affect the prolongation of the inter-repair terms of capital repairs of an apartment building, and the ranking of ranks was made because of expert assessments. The vector of priorities for drawing up a curve of indicators of importance of estimated criteria is calculated.

1. Introduction

Normative service life of residential buildings-an indicator that is set depending on the materials of manufacture, supporting structures, conditions of maintenance and use. In fact, by the end of this period, most of the important components of the building do not exhaust their reserves of strength, so they can be safely used for a considerable time. [1-4]

In the process exploitation constantly is conducted the current preventive (camping on E. in advance planned on community, costs and volume of) [5], and in case needs and unforeseen renovating any something systems and designs homes. Building structures are exposed not only to the force of the load, but also to the aggressive influence of the environment-a variety of corrosion, from which the structure must be protected. [6] when properly repaired, buildings can last much longer.

For the purpose of prolongation of inter-repair terms of capital repairs of apartment houses it is necessary to consider factors which have essential influence on frequency of carrying out capital repairs. [7-9]

2. Materials and Methods

The study used methodologies that are reflected in such works as: Evlanov L. G. "Expert assessment in management", King O. A. "Organizational and technological mechanism of implementation of energy-saving measures in the construction of monolithic housing". This indicates that the data obtained are reliable.



3. Results and discussions

Thus, the study identified the following main factors:

F1-Improving the quality of repair and construction works; [8]

F2-Increase the durability of materials; [4]

F3-equal Strength of materials of structural elements and systems;

F4-Improving the level of engineering improvement;

F5 - increasing the energy efficiency of the building; [9-10]

F6-Maintainability;

F7 - application of adaptive modern design solutions; [9]

F8-Maintainability.

Table 1 presents expert estimates for the selected factors. 8 experts participated in this survey.

Table 1. Expert evaluation

Expert number	Factors							
	F1	F2	F3	F4	F5	F6	F7	F8
1	8	10	10	8	6	5	2	2
2	9	9	10	9	7	7	4	3
3	7	8	8	10	7	6	5	4
4	7	10	7	8	8	7	5	5
5	9	10	8	9	5	5	4	4
6	10	10	10	8	6	6	3	3
7	7	10	9	8	6	4	2	2
8	5	9	9	10	7	5	3	3

We will carry out statistical data processing, namely, we will determine the consistency of experts' opinions by identifying the concordance coefficient. Concordance coefficient-is defined in the range from 0 to 1. If the value is close to 0, the consistency is considered low, from 0.3 to 0.7 consistency is considered average, more than 0.7 – high.

To do this, calculate the sum of the ranks, the deviation from the mean and the square of the deviation.

Table 2. Calculation of the sum of ranks

Expert number	Factors							
	F1	F2	F3	F4	F5	F6	F7	F8
1	4	1	2	3	5	6	8	7
2	3	2	1	4	6	5	8	7
3	4	1	3	2	5	6	7	8
4	4	1	2	3	5	6	8	7
5	2	3	1	4	6	5	7	8
6	5	1	2	3	4	5	7	8
7	4	1	2	3	5	6	8	7
8	4	2	1	3	5	7	6	8
The sum of the ranks	30	12	14	25	41	46	59	60
The deviation from the average	-5.875	-23.875	-21.875	-10.875	5.125	10.125	23.125	24.125
Squared deviation	34.515	570.015	478.515	118.265	26.265	102.515	534.765	582.015
Σ								2446.875

We determine the value of the concordance coefficient by the formula (1):

$$W = \frac{12 \cdot S}{m^2(n^3 - n)} \quad (1),$$

where S is the sum of squared deviations of the rank sum, m is the number of experts in the group, n is the number of factors.

In our case, the concordance coefficient is 0.91, which indicates a high degree of consistency of experts' opinions. Table 3 shows the ratio of the identified factors to the ranks of significance.

Table 3. Awarding ranks to factors

	F1	F2	F3	F4	F5	F6	F7	F8
Rank of importance	4	1	2	3	5	6	7	8

In order to build a diagram of the importance indicators of evaluation criteria [10] for the selected factors, it is necessary to calculate the vectors of priorities.

The values of the indicator of the importance of the event are determined by the formula (2)

$$K = \frac{2(n-i+1)}{n(n+1)} * 100 \quad (2)$$

where n - is the number of events; i - is the rank of the event.

Table 4. Indicators of the importance of the event

	F1	F2	F3	F4	F5	F6	F7	F8
K	13.88	22.22	19.44	16.66	11.11	8.33	5.55	2.77

We create a matrix of pair comparisons for the considered events according to the expression:

$$\Omega_{i,j} = \frac{K_i}{K_j} \quad (3)$$

$\Omega_{1,1}=1$	$\Omega_{1,2}=0.62$	$\Omega_{1,3}=0.71$	$\Omega_{1,4}=0.83$	$\Omega_{1,5}=1.25$	$\Omega_{1,6}=2.67$	$\Omega_{1,7}=2.50$	$\Omega_{1,8}=5.01$
$\Omega_{2,1}=1.60$	$\Omega_{2,2}=1$	$\Omega_{2,3}=1.14$	$\Omega_{2,4}=1.33$	$\Omega_{2,5}=2$	$\Omega_{2,6}=2.66$	$\Omega_{2,7}=4$	$\Omega_{2,8}=8.02$
$\Omega_{3,1}=1.40$	$\Omega_{3,2}=0.87$	$\Omega_{3,3}=1$	$\Omega_{3,4}=1.17$	$\Omega_{3,5}=1.75$	$\Omega_{3,6}=2.33$	$\Omega_{3,7}=3.50$	$\Omega_{3,8}=7.01$
$\Omega_{4,1}=1.20$	$\Omega_{4,2}=0.75$	$\Omega_{4,3}=0.86$	$\Omega_{4,4}=1$	$\Omega_{4,5}=1.50$	$\Omega_{4,6}=2$	$\Omega_{4,7}=3$	$\Omega_{4,8}=6.01$
$\Omega_{5,1}=0.80$	$\Omega_{5,2}=0.50$	$\Omega_{5,3}=0.57$	$\Omega_{5,4}=0.67$	$\Omega_{5,5}=1$	$\Omega_{5,6}=1.33$	$\Omega_{5,7}=2$	$\Omega_{5,8}=4.01$
$\Omega_{6,1}=0.60$	$\Omega_{6,2}=0.37$	$\Omega_{6,3}=0.43$	$\Omega_{6,4}=0.50$	$\Omega_{6,5}=0.75$	$\Omega_{6,6}=1$	$\Omega_{6,7}=1.50$	$\Omega_{6,8}=3$
$\Omega_{7,1}=0.39$	$\Omega_{7,2}=0.25$	$\Omega_{7,3}=0.28$	$\Omega_{7,4}=0.33$	$\Omega_{7,5}=0.50$	$\Omega_{7,6}=0.66$	$\Omega_{7,7}=1$	$\Omega_{7,8}=2$
$\Omega_{8,1}=0.19$	$\Omega_{8,2}=0.12$	$\Omega_{8,3}=0.14$	$\Omega_{8,4}=0.17$	$\Omega_{8,5}=0.25$	$\Omega_{8,6}=0.33$	$\Omega_{8,7}=0.50$	$\Omega_{8,8}=1$

Let us define vectors of priorities. To do this, first multiply $n = 8$ elements of each row and extract the root of the n th (8th) degree:

$$N_i = \sqrt[8]{\Omega_{1,1} \times \Omega_{1,2} \times \Omega_{1,3} \times \Omega_{1,4} \times \Omega_{1,5} \times \Omega_{1,6} \times \Omega_{1,7} \times \Omega_{1,8}} \quad (4)$$

Table 5. The vectors of priorities of the factors

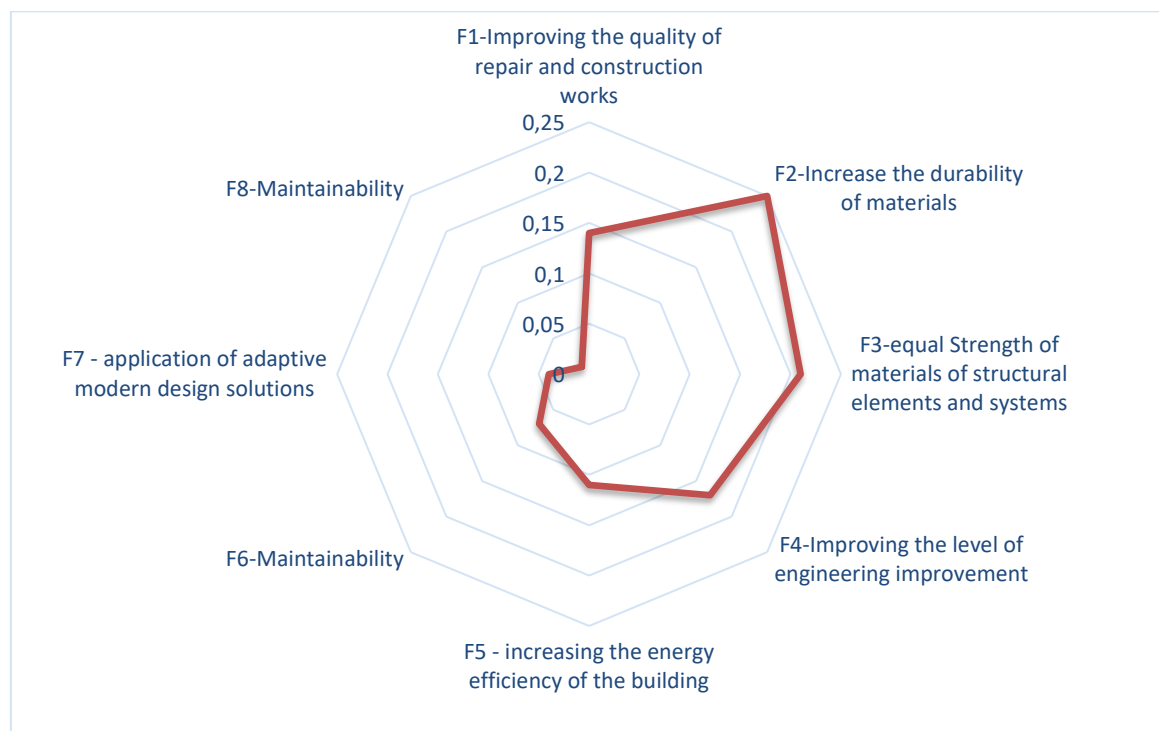
	F1	F2	F3	F4	F5	F6	F7	F8
N	1.57	2.73	2.28	1.86	1.22	0.74	0.43	0.16

Then we normalize the obtained numbers to create a curve of indicators of the importance of the evaluation criteria for the selected factors by the formula (4)

$$\alpha = \frac{N_i}{\sum_{i=1}^n N_i} \quad (4)$$

Table 6. Normalization of the vectors of priorities.

	F1	F2	F3	F4	F5	F6	F7	F8
α	0.14	0.25	0.21	0.17	0.11	0.07	0.04	0.01

**Figure 1.** Indicators of the importance of evaluation criteria for selected factors.

4. Conclusions

Based on the study, it can be concluded that the most significant factors that affect the prolongation of overhaul periods of overhaul is: increasing the durability of materials and ensuring equal strength of materials used structural elements and systems.

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