Influence degree of constrained conditions on overhaul of apartment buildings

Rustam Fatullaev[1,*]

[1]Moscow State University of Civil Engineering, 26 Yaroslavskoe shosse, Moscow, 129337, Russia

Abstract. When carrying out the repair and construction work in the apartment buildings and when creating an organizational and technological model, it is necessary to take into account and analyze all the parameters that influence on these works to optimize the time and financial costs. The complicating conditions of the construction works can be caused by the repair work, which are made without the relocation of the residents, the existence of the high-voltage networks, the presence of the constrained conditions, the material storage and etc. In order to give an objective assessment of the organizational and technological model of the repair and construction works, this article proposes to introduce a complex indicator of the constrained condition influence, which quantitatively reflects the influence degree of the set constraint parameter. This model gives a quantitative assessment of the influence degree of the constraint parameters and allows selecting the most effective organizational and technological model for the repair and construction works.

1 Introduction

The overhaul of apartment buildings is a complex system, which has its own characteristics in comparison with new construction. Overhaul planning includes an assessment of organizational and technological solutions. The existing principles for assessing organizational and technological decisions in organizing and planning the overhaul of apartment buildings do not take into account all possible parameters affecting the efficiency of repair work.

The use of the overhaul potential developed in previous studies allows taking into account the polyparametry of the object [1] in which the overhaul is planned. The method of calculating the potential helps to determine the necessary list of work on the overhaul and the priority sequence of work when planning overhaul [2]. Knowledge of the priority sequence of work allows you to choose the most effective composition of work under financial and other constraints.

A feature of the use of potential is that the results obtained from the application of the potential are presented in quantitative form.

* Corresponding author: FatullaevRS@mgsu.ru

The potential of organizational and technological processes of construction production was studied and integrated by such scientists as A. Lapidus, D. Topchiy, A. Goncharov, A. Makarov, P. Govorukha.

Due to the fact that the main consumer is a resident of an apartment building, the aim of the research is to create a system in which data input and output using the potential will be intuitive for the user.

The purpose of the work is the development of an organizational-technological model of an object in which an overhaul is planned, allowing us to assess the degree of influence of constrained conditions on the choice of organizational and technological solutions.

Research objectives: analysis of scientific papers on the organization of the construction industry; analysis of factors affecting the constrained conditions parameter; description of the methodology for the degree of parameter influence on organizational and technological decisions; analysis of research results.

Scientific and technical hypothesis: the assumption of the possibility of improving the efficiency of the methodology for assessing and making organizational and technological solutions in organizing the overhaul of apartment buildings using the potential of the overhaul, by assessing the degree of influence of various factors on the parameter of constrained conditions.

2 Methods

The method of expert assessments consists in the rational organization of the analysis of the problem by experts with the quantitative assessment of judgments and the processing of their results. A generalized expert group opinion is accepted as a solution to the problem. In the decision-making process, experts carry out information and analytical work on the formation and assessment of decisions. [1]

Using the method of the expert assessments of the chosen parameters, their importance degree is assigned in the quantitative measurement (the degree of weight of each parameter, taking into account its influence on the duration and complexity of measures for its elimination/leveling).

A model is an abstract representation of an object in mathematical form, designed to represent certain aspects of this object and provides answers to the questions being studied [2,3]. Organizational and technological systems are formed using the functional and systemic approach. The organizational and technological system consists of separate, but interrelated elements - subsystems [4]. A subsystem is a set of system elements interconnected and performing a relatively independent task (several tasks) related to the objective of achieving the goals of the system [5,6].

For the case proposed in this study, the organizational and technological system includes 15 subsystems [7]. As a result, the main task is to identify subsystems with certain limitations that ensure the achievement of goals. Subsystems are presented as an integral part of the system and allow achieving a local result [6], which leads to a general result. It is required to determine the functional purpose of each subsystem and determine their limitations

3 Results

Based on the results of the obtained scores for each parameter, a mathematical model is developed for calculating the complex index of the constrained condition influence on the repair and construction works in the apartment buildings (P_{cc}). [4]

To determine the effectiveness degree of the organizational and technological decisions taken in the context of the existing internal infrastructure of the apartment buildings, it is proposed to introduce an evaluation index of the influence degree of the constrained conditions on the repair and construction works in the apartment buildings (P_{cc}). [4]

As a result of the scientific literature analysis on the organization of the repair and construction works, the following parameters can be distinguished (Table 1):

Table 1. Parameters

Parameter group	**Parameter**
existing (with modifications) engineering infrastructure, including [4]	water supply (x_1)
	heating (x_2)
	ventilation (x_3)
	internet, telephony (x_4)
	power supply network (x_5)
existing household infrastructure [4]	cluttering of the floors with personal belongings (x_6)
	additional doors (x_7)
	joint use of the lifting mechanism (elevator) (x_8)
	impossibility of the carrying large-sized building materials (x_9)
"Red lines" of the construction site [8]	impossibility to locate the production facilities (x_{10})
	impossibility to locate the workshops (x_{11})
	impossibility to locate the storage areas for the materials locate (x_{12})
other factors [4]	impossibility to use the large-scale mechanization facilities (x_{13})
	impossibility of the organizing the storage sites for construction debris (x_{14})
	impossibility of the carrying out the works at night, during weekends and holidays (x_{15})

To determine the influence degree of the presented parameters on the repair and construction works in the conditions of the existing internal infrastructure of the apartment buildings, the method of expert assessments was selected [8].

100 experts, who are the heads of the large and medium-sized organizations that carry out the overhaul of the apartment buildings and structures in Moscow and have special knowledge and experience in the organizing of the repair work and also having a construction education, were interviewed [9]. The competences of the respondents corresponded to the requirements for the term "expert" in accordance with the Article 57 of the Arbitration Procedure Code of the Russian Federation.

To assign a quantitative value to each index or to reject it as not related to the constrained conditions during repair work, a questionnaire was formed, in which

the previously presented constraint parameters were presented. The experts were asked to quantify each parameter. The influence degree of each specific parameter was assessed on a scale from "1" to "5", namely:
"1" - the parameter is predominantly not related to the specifics of the work in the constrained conditions;
"2" – it occurs rarely, does not require the use of special organizational and technological solutions;
"3" – it occurs constantly, does not require the use of special organizational and technological solutions;
"4" - it occurs rarely, requires special organizational and technological solutions.
The form of the questionnaire is presented in Table 2.

Table 2. The form of the questionnaire.

Parameter	**Evaluation Criteria**				
	1	2	3	4	5

The result of estimating the i-th parameter was calculated as the average value of the estimates j-th expert as follows:

$$K_{av} = \frac{\sum_{I=1}^{N} m_{ji}}{N} = \frac{1}{N}\sum_{j=1}^{N} m_{ji} = \frac{m_{ji}}{N} \quad (1)$$

Where: m_{ji} - assessment of j-th expert, which was given to them on the i-th parameter; N - total number of the experts.
The results of determining the average values of the estimates are presented in Table 3.

Table 3. Average value of parameter estimates.

	Numbering of parameters														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Average Value Estimates of i-th parameter	3.59	3.65	3.51	3.24	3.73	3.41	3.41	3.74	4.2	3.78	3.74	3.68	4.1	3.89	4.1

Based on the results of the questionnaire, each of the parameters is assigned the corresponding weight of the parameter v_i. The weight of the parameter reflects the significance of each of the parameters evaluated in the quantitative measurement.
The sum of all the weights of the parameters should be taken equal to "10".

Table 4. Weights of parameters.

	Numbering of parameters														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Weights of parameters	0.661	0.67	0.642	0.631	0.682	0.682	0.651	0.682	0.721	0.689	0.694	0.688	0.703	0.697	0.705

According to the majority of the experts involved in the assessing the influence degree of the constraint in the conditions of the dense urban development, the parameters are arranged due to the degree of the occurrence frequency in the following order:

$$x_{15}; x_{11}; x_{13}; x_6; x_{12}; x_{10}; x_{14}; x_8; x_7; x_4; x_3; x_1; x_9; x_2; x_5$$

To create a mathematical model, each of the presented parameters was assigned a designation in the $P_1, P_2 \ldots P_{15}$ form.

The results of the survey showed that all the presented parameters have a significant weight when the organizing and conducting the repair and construction works. Thus, we can conclude that there is no need to exclude any of the presented parameters. A complex index of the influence of the constrained conditions must be calculated taking into account all the presented parameters [10,11].

The mathematical model of the complex index calculation of the influence of the constrained conditions (P_{cc}) in the following form:

$$P_{cc} = \sum_{i=1}^{n} v_i * P_1 = v_1 * P_1 + v_2 * P_2 + \cdots + v_{15} * P_{15} \quad (2)$$

Taking into account the weights obtained as a result of the experts' questionnaire, the model acquires the following form:

$$P_{ex} = 0{,}661 * P_1 + 0{,}67 * P_2 + \cdots + 0{,}705 * P_{15} \quad (3)$$

When working with this model, the influence values of the parameters (P_i) will be evaluated using the following values:

"-1" - measures to eliminate this parameter are fully possible;

"0" - measures to eliminate this parameter can be carried out in part;

"1" - it is impossible to eliminate this parameter.

Thus, the P_{ex} values will always be within:

$$-10 \leq P_{ex} \leq 10 \quad (4)$$

4 Conclusions

The developed model allows estimating the degree of the influence significance of the constrained conditions on the carrying out the repair and construction works in apartment buildings. Based on the analysis results, we can draw a conclusion about the most significant parameters, which makes it possible to rationally distribute their efforts to minimize their influence.

This model has an open character, which means that it can be supplemented for a more objective result.

References

1. A. Lapidus, I. Abramov, Science and Business **10**, 17-28 (2017)
2. A.A. Lapidus, A.N. Makarov, Bulletin of Moscow State University of Civil Engineering, **8**, 150-160 (2015)
3. A.O. Khubaev, Prospects of science, **4(103)**, 57-61 (2018)
4. R.S. Fatullaev, E3S Web Conf. XXII International Scientific Conference “Construction the Formation of Living Environment” (FORM-2019), **97**, 06035 (2019)
5. V.Y. Mishchenko, D.I, Yemelyanov, A.A. Tikhonenko, Industrial and Civil Engineering, **10**, 69-71 (2013)
6. R.S. Fatullaev, Components of Scientific and Technological Progress, **3(33)**, 17-22 (2017)

7. A. Khubaev, T. Bidov, A. Bzhienikov, V. Nesterova, IOP Conf. Series: Materials Science and Engineering, **365**, 81-96 (2018)
8. A. Lapidus, T. Bidov, A. Khubaev, MATEC Web of Conferences, **117** (2017)
9. M. Liu, G. Ballard, *Proceedings for the 16th Annual Conference of the International Group for Lean Construction*, Planning and Control, **1**, 657-666 (2008)
10. L. Floreza, J.C. Cortissoz, Procedia Engineering, **164**, 42 – 48 (2016)
11. A. A. Fard Fini, T. H. Rashidi, Journal of Construction Engineering and Management, **1**, 28-41 (2016)