Organisational and technological design improvement of reconstruction of large-paneled residential buildings of the first mass series

Aleksandr Shepelev 1,*, Galina Severova 1, Alekseandr Kolosov 2, Alexander Bahmetev 2, and Tamara Narezhnaya 3

1 Northern (Arctic) Federal University named after M.V. Lomonosov
2 Voronezh State Technical University, 20 letiya Oktyabrya Street, 84, 394006, Voronezh, Russia
3 Moscow State University of Civil Engineering, 26, Yaroslavskoye sh., 129337, Moscow, Russia

Abstract. The article deals with the experience and results of the research in the field of technology and organisation of five-storey large-paneled residential buildings reconstruction of 1-464A series. For this purpose, the new combined organisational and technological models for two stages of reconstruction are successfully developed and implemented. As a result of theoretical research and practical developments, the methodology of formation of rational organisational and technological solutions for reconstruction of residential buildings of the first mass series is proposed and successfully applied, on the basis of which the mandatory sections of the project of works production for reconstruction of the investigated object are designed.

1 Introduction

One of the main trends in state urban planning and housing policy in Russia for a long period of time is the implementation of measures to ensure the renewal of five-storey panel housing in cities on the basis of reconstruction, major repairs and modernisation. In modern conditions, the development and implementation of regional reconstruction programmes of residential buildings of the first mass series allow not only to maintain the panel housing stock in satisfactory technical condition, but also to provide a significant urban planning and socioeconomic effect by updating the urban environment and obtaining additional area of residential buildings in existing urban areas [1-3]. According to [4], reconstruction of a capital construction object is a change in its parameters (height, number of floors, volume, area ...), including superstructure, remodelling, expansion, as well as replacement, restoration of load-bearing building structures.

It is known that in the design of reconstruction of residential buildings of the first mass series a great experience in the development of architectural, construction and technical solutions has been accumulated [5-8]. At the same time, studies show that significant reserves of reconstruction efficiency growth lie in the field of organisational and...
technological design [3, 6, 9, 10]. At the same time, more and more attention in research is paid to the transition to the complex reconstruction of residential formations - neighbourhoods, quarters and their parts (queues, residential groups); it is justified economically, technologically and organisationally, which is repeatedly confirmed in the conditions of new construction [2, 3, 11].

The current regulatory and methodological base in construction establishes that the erection of each object is allowed to be carried out only on the basis of pre-developed organisational and technological solutions, which should be adopted in Construction Organisation Projects (COP) and Work Production Projects (WPP) [2, 3, 11-13]. However, the problem of developing rational standard organisational and technological solutions for the reconstruction of residential buildings of the first mass series, based on modern methods of construction production modelling, including optimised scheduling, has not received enough attention so far.

In the conditions of competition and the desire of contractors to meet the contractual deadlines, the application of methods of optimised scheduling based on the complex use of modern mathematical and organisational-technological modelling, adequate to the real conditions and specifics of flow production of works in the reconstruction of objects and their complexes, becomes more and more relevant.

Thus, it is relevant, timely and useful to develop, on the basis of the performed research, a methodology for the formation of optimised organisational and technological solutions for the reconstruction of five-storey large-panel residential buildings of the first mass series, based on the use of network models that are most adequate to the real construction production.

2 Materials and Methods

...
3 Outcomes of the work project main sections’ development on the facility reconstruction

Table 1. Basic TEI by options of work organisation

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Measurement</th>
<th>Unit</th>
<th>I stage</th>
<th>II stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total duration of work</td>
<td></td>
<td></td>
<td>178</td>
<td>165</td>
</tr>
<tr>
<td>Labour costs</td>
<td></td>
<td>person/day</td>
<td>2848</td>
<td>2970</td>
</tr>
<tr>
<td>Average number of workers per day</td>
<td></td>
<td></td>
<td>16</td>
<td>18</td>
</tr>
</tbody>
</table>

4 Outcomes of the work project main sections’ development on the facility reconstruction

As a result of the research carried out at the Department of Roads and Construction Production, and the corresponding organisational and technological design, the authors have developed a set of organisational and technological documentation, including the main documents of the design and construction process, for the stages of reconstruction of the object under consideration, described above.

Within the organisational-technological documentation the following new technological cards have been developed taking into account modern requirements [13]: for the staircase construction between the existing and attic floors, for the installation of attic structures, for the metal tile roofing (for stage I) [15]; for the ventilated facade construction (for stage II of reconstruction) [16]. In this case, the use of large construction machines is minimised due to the reconstruction without eviction of tenants, and for the supply of materials for the construction of the attic, a cargo construction lift is adopted.

As a result of comparison of the main variants of organisational and technological solutions, the final variants with the shortest (technically possible) duration of works on the stages of reconstruction (165 and 106 days, respectively), as the most satisfying the needs of the customer and the building occupants, the capabilities of the contracting company, and corresponding to the duration of the warm period of the year (especially for the II stage of reconstruction, which takes about 5 months) were adopted. On this basis, other elements of the design construction project have been developed, including:
### Table 2. Basic TEI of the facility before and after reconstruction

<table>
<thead>
<tr>
<th>Types of flats and general indicators</th>
<th>Basic building parameters</th>
<th>Change, % before reconstruction</th>
<th>after reconstruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Studio flat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of apartments, pcs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dwelling area, m²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total area, m²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One-bedroom flat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of apartments, pcs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dwelling area, m²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total area, m²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two-bedroom flat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of apartments, pcs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dwelling area, m²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total area, m²</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The complex development is coordinated with the general contractor; it was carried out in parallel with the first experience of reconstruction of similar buildings in the city and therefore takes into account the solution of the issues arising in this case, and therefore, will find wide application in the reconstruction of similar objects; the developed methodology of formation of organisational and technological solutions on the basis of standard network calendars; schedules of labour, material and technical resources requirements; construction master plans (for the relevant stages).
modelling is also applied by us on other objects - brick residential buildings in the cities of Arkhangelsk and Severodvinsk.

The network models developed in the process of research, timetable plans for reconstruction of objects, technological maps and other organisational and technological documentation, collected information materials are used in course and diploma design, study of special disciplines by students of the Higher Engineering School.

4 Results

Based on the above, we can conclude that the research goal has been achieved - the methodology of forming rational organisational and technological solutions for the reconstruction of residential buildings of the first mass series has been developed and successfully applied. The proposed methodology has shown sufficiently high efficiency and has good prospects for further application and improvement, including in the directions of organisational and technological design of complex reconstruction of residential quarters and in the planning of work on the implementation of the production programme of construction and installation companies. The research results are recommended for design, construction and design-building organisations and enterprises.

5 Conclusion

Thus, the results of scientific research and practical developments to improve the process of organisational and technological design of reconstruction of residential buildings of the first mass series allow us to objectively assess the possibility of effective application of the developed methodology and proposed models for real planning and management in construction production, as well as for the training of students at universities in the field of "Construction" and advanced training of specialists.

Conflict of interest

The authors confirm that the presented data do not contain a conflict of interest.

References

1. S.N. Bulgakov, V.V. Leontiev, Recompensed reconstruction of residential buildings of the first mass series (Publishing House of the DIA, Moscow, 2016)
2. L.V. Kievskiy, City development: Collection of research papers 2006-2014 (2014)
4. City Planning Code of Russian Federation, Moscow, Prospect (2022)


