Methodology for systematic analysis of buildings for reconstruction

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Abstract: The article considers the methodology of systematic analysis of the reconstruction buildings.

The article considers the methodology of systematic analysis of the reconstruction buildings. Based on the conducted research, the paper makes the following conclusions: in order to avoid subjective opinions of experts (especially at the first stages), the plan of the process of recommended building reconstruction provides the possibility to identify a number of formal methods and procedures as much as possible, which makes the process more efficient and allows to maximize the use of automation and computer technologies, which increases the efficiency of construction inspections, reduces production time, as well as cost and time.

Keywords: reconstruction, building, analysis, methodology, structural diagram**.**

1. Introduction

The system approach to the study of complex building structures in building reconstruction is of a comprehensive nature. The reconstruction building is considered as a complex system with all necessary attributes: the presence of subsystems (elements) united by links (physical, logical, mathematical), as well as the fulfillment of the condition of functional integrity. In the study of building structures of the reconstruction building the following basic logical elements are distinguished in the system analysis: goal (or goals); study of alternative means to achieve the goal (physical or mathematical modeling); resources for problem solving; systems of connection between goals, means and resources, criteria for selecting preferred alternatives.

2. Main body of the paper

With the system approach, the choice of methods of research of building structures of the building needing reconstruction or changing the functional purpose is made taking into account their role as a whole. Optimal characteristics of the system elements, physical non-mathematical models are considered as a single means of achieving the goal. Therefore, physical and numerical experiments should be coordinated with each other from the very beginning, should be oriented to the effective solution of the research problem and complement each other when considering the research process of the building construction as a separate system. Three main subsystems should be distinguished:

Experimental research on physical models of building renovation; computational research on mathematical models; linking the experiment with the report, which includes identifying some parameters of the computing model, checking its adequacy and correction. At the same time, the use of mathematical methods is still important due to the disproportion between and the high level of automation of the calculation process itself and the algorithms for the construction of calculation models of real buildings what allows obtaining the results depending on the subjective features of the study. Reliable results can be obtained experimentally. However, due to the complexity of the instructions and facilities, the labor intensity, cost and time of the research increase significantly. This is also true for physical modeling methods.

The reconstruction project should present principled approaches to optimize the process of research of complex structures on the basis of system analysis. In addition, physical and mathematical modeling of the buildings for reconstruction should be rationally coordinated in solving the presented problem. Mathematical methods are the main reference. Physical experiment is used only to refine and verify the reference model of the

reconstructed building. This has prompted the use of focused physical models developed based on functional similarity, which simplifies the construction models of the building under reconstruction and reduces the cost of experiment supplies. In research the maximum possible distinction of formal methods allows to reduce the influence of subjective factors on the results. It is necessary to use automation. At the same time, it should be noted that the role of informal methods remains important in the study of complex structures of a reconstruction building, which makes the process of the research a combination of scientific methods and the experimenter's art.

When a building is reconstructed or its purpose is changed, it is increasingly necessary to develop mathematical and physical models for the study of building structures.

The principal approaches to optimize the process of studying complex building structures of buildings under reconstruction on the basis of system analysis are presented below. In addition, physical and mathematical modeling is rationally coordinated in solving the given problem. Mathematical methods are the main means. Physical experiment is used only to refine and verify the reference model of the reconstructed building. This has prompted the use of focused physical models developed based on functional similarity, which simplifies the construction models of the building under reconstruction and reduces the cost of experiment supplies.

The unity of physical and mathematical models leads to the uniformity of description of their characteristics and effects (input parameters), as well as to the uniformity of functional parameters of their state (output parameters), for which symbols and some basic definitions of the theory of algorithms and set are used. The features by which a reconstruction building differs from others form a set of parameters P. The change of external conditions affecting the state of a reconstruction building is characterized by a set of load effects N=$\{n_k\}$. It is clear that the sets P and N contain only properties and effects related to the studied building reconstruction tasks. As a rule, they are defined together with the reconstruction task before the research begins.

In the computational models of the reconstruction building, the set P is divided into two subsets: M=$\{m_2\}$ (building parameters known a priori) and X=$\{x_i\}$ (parameters to be determined during the building survey). Thus P =MUX. Thus, the result of the building survey is a set of stress-strain state parameters Y=$\{y_i\}$.

The sets P and Y should unambiguously characterize the state and behavior of the reconstructed building in the aspect of interest to the researcher both before and after the application of influences N. When solving the problems of a particular study building, it is necessary to pay attention to the correctness of their choice. We are guided by the fact that a functional correspondence is established between the sets N, P and Y of the reconstructed building, which is as follows:

For every $P_s \in$ P and $n_k \in$ N

corresponds to at least one element $y_i \in$Y

For every $y_{i\tau} \in$Y

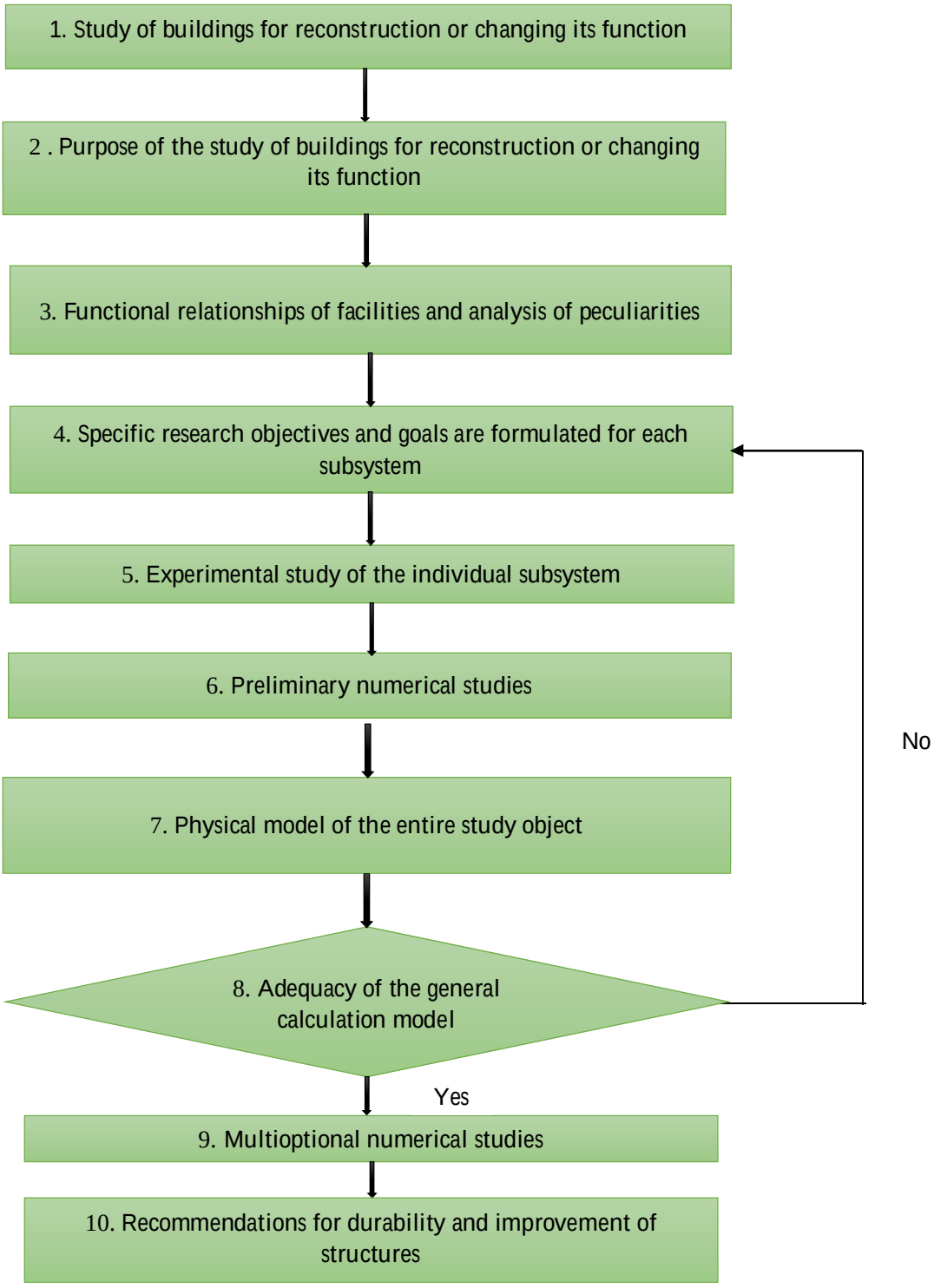
For every $y_{i\tau} \in Y$

corresponds to a single non-empty set $\vec{P}<$ P and $\vec{N}<$ N

In addition, the existence of some functions is likely

$$y_i = f_i, \vec{N}.$$

A block diagram of the building to reconstruct survey process is developed, which is shown in Fig. 5.


1. Study of buildings for reconstruction or changing its function
2 . Purpose of the study of buildings for reconstruction or changing its function
3. Functional relationships of facilities and analysis of peculiarities
4. Specific research objectives and goals are formulated for each subsystem
5. Experimental study of the individual subsystem
6. Preliminary numerical studies
7. Physical model of the entire study object
8. Adequacy of the general calculation model
No
Yes
9. Multioptional numerical studies
10. Recommendations for durability and improvement of structures

The considered system approach allows us to present the process of investigation of stress-strain state of complex structures of a building for reconstruction as a structural block diagram (Fig. 5), which will allow us to approach our goal more effectively.

Block 1. The study of complex building structures subject to reconstruction or change of functional purpose should begin with a detailed analysis of the object of research and a detailed analysis of the current issues on the problem:

- Study of the working drawings and other documentation of the study building;
- Analyzis of the functional purpose and working conditions of the building;
- Identification of distinctive features and peculiarities in comparison with previously studied similar buildings;
- Familiarization with the methods and results of previously conducted building research.

Based on the analysis, the importance and novelty of the problem will be assessed, the research task is specified taking into account the existing resources, their needs and possible policy constraints on them.

Block 2. After specifying the task, the objective(s) of the building investigation is formulated what is very important because the organization of the task solution, its strategy and tactics depend on the clarity of the objective. It is the correctly chosen goal allowing for rational allocation of resources. The researcher's work at this stage is characterized by the following principles:

- Breaking down the overall goal into more specific sub-goals;
- When defining the goal, setting the parameters that will allow us to do the following in a clear and specific way:
- To the extent posisble, formulating several options of the goal depending on the need for resources to achieve it, analyzing and evaluating the allocation of available resources. After setting the final goal, the master plan (program) of the building survey: the methods of organizing work and solving the presented tasks will be developed. Since there are practically no formal methods at the first stage of the building survey, they should be developed by a high-level performer.

Block 3. The functional relationships of the buildings being reconstructed and peculiarities of operation of individual elements for possible decomposition of complex systems into simpler subsystems are analyzed.

Block 4. After breaking down, the goals and objectives of the Shannon private study are formulated for each subsystem. Accordingly, for each i-subsystem a more appropriate a priori computational model is selected and Mi set of known values, Xi set of unknown values, Hi own systems of impacts and Yi parameters of the stress-strain state are determined.

Block 5. After breaking down, the goals and objectives of the Shannon private study are formulated for each subsystem. The parameters Yi of the stress-strain state, necessary for further determination of the unknown parameters Xi of the corresponding calculation models, are also determined experimentally.

Block 6. Preliminary numerical studies of the calculation models of subsystems of the building under reconstruction are performed. According to the experimental data, the unknown parameters Xi of the building calculation models are determined and the general calculation system of the study building is synthesized.

Block 7. Based on a similar functional

method, a physical model of the whole reconstructed building will be developed and its experimental study will be performed.

Block 8. The adequacy of the general calculation model of the building to the statistical results of the experiment and numerical study of the functionally similar model is verified. If such verification gives a positive result, we proceed to the following procedures; Otherwise, the reasons for inadequacy are detected and the general calculation model is refined with new versions of calculation models of individual subsystems of the reconstructed building.

Block 9. After determining the adequacy of the calculation model, multivariate numerical studies are performed, the scope of which is necessary to answer the research questions posed to the researchers.

Block 10. The results of the reconstruction building survey are formed by recording the achievement of the set goal using the relevant procedure. As a rule, the research is completed with recommendations of the improvement of the reconstruction building design.

The block diagram presented during the studies is not the only one: depending on the type of study, some blocks may be ignored, or extra blocks may appear and their sequence may change as well. The strategy of selection and construction of the calculation model of the building to reconstruct or changing function adequate to the natural one reconstruction does not change.

3. Conclusion

As a result of the research conducted in the article it was established: in order to avoid subjective opinions of experts (especially in the first stages) in the plan defining the recommended process of reconstruction of the building makes it possible to identify a number of formal methods and procedures, which makes the process more efficient and allows to maximize the use of automation and computer technology what improves the efficiency of construction inspections and reduces labor capacity, cost and time of production.

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