

Organizational and technological forecasting and justification of the final stages of the life cycle of the construction project

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Abstract: The investment and construction industry demonstrates a steady trend of accelerating the moral and physical wear and tear of fixed assets. In these conditions, methods for forecasting the most probable transformations of the construction project, of organizational and technological methods for dismantling of structures, of application and disposal of used materials, and of the complete liquidation of the facility become in demand. The organizational and technological transition of the construction industry into the closed life cycle of the construction object becomes the actual and priority strategic goal. The transition methodology assumes that the conceptual stage of design is supplemented by forecasting the final stages of the building's life cycle, which includes ensuring the processability of liquidation of the real estate object and planning the full life cycle of the facility. To do this, at the early stages of design, the most probable time for the moral and physical aging of the structures and engineering systems of the object is determined; the most probable tasks of modernization, reconstruction and liquidation are identified; substantiated and provided for by organizational and technological solutions, corresponding to the tasks of reconstruction and liquidation of the project. Obviously, with the current scale of construction, the urban development area should be considered in the project as a common space of vital activity. Accordingly, the goals and interests of participants in the life cycle of the building should be implemented predictably and manageable in the direction of integrating goals and interests on the basis of ecosystem thinking. We need to predict and evaluate the likely reactions of socio-economic and ecological systems, and in accordance with this, adjust the goals, directions and scale of investment in construction. The development of applied research in this area will make it possible to bring investment and construction activities to a new level of environmental safety and sustainable equilibrium of built-up areas.

1. Introduction

Regularities in the development of the investment and construction sector show a long and steady trend of accelerating all types of moral and physical depreciation of fixed assets, which requires constant renovation of buildings and structures. In these conditions, it is actual to forecast the potential transformations of the construction project, including the tasks of dismantling and demolition of structures, complete liquidation of the building, application and disposal of used materials, up to reclamation of the construction site. All kinds of changes, construction transformations and object liquidation become not only more and more significant, but also constitute a compulsory, organizationally and technologically very long, labor-consuming and costly stage in the life cycle of a real estate object.



In practice, the moral and physical wearout of the building object, as well as the legitimate tasks of its inevitable liquidation, are usually overlooked in the design process. The adaptive resource of the building and its processability of liquidation are not generally considered in the project due to their remoteness in time, uncertainty and the need for additional costs for these purposes. At the same time, based on the representative experience of development of vast built-up urban areas and redevelopment of real estate objects accumulated in Moscow and other large Russian cities, it is possible to determine the design of engineering solutions for project transformations and object liquidation not just as urgent tasks, but as necessary tasks in the conceptual designing.

2. Materials and methods

Practice shows that the processes of capital repair and liquidation of even such structurally simple buildings as five-storey panel houses, which are not envisaged at the time in the projects, put a lot of complex engineering, organizational and technological issues. This is the impossibility of replacing the risers of sewerage, hot and cold water supply during the capital repair of the building, these are problems of demolition and disassembly of buildings in conditions of dense urban planning, collection and removal of waste from demolition, recycling of construction materials, reduction of construction debris and many others. There are also more serious problems. At present, large-scale redevelopment projects of urban industrial zones, technical zones of railways, power transmission lines and similar territories are being implemented in the Moscow region and other regions, in which appear engineering and technological and organizational tasks of dismantling, demolition and liquidation of complex building structures. This requires both significant costs and special organizational and technological projects. Moreover, when solving the tasks of eliminating obsolete unique building and structures (for example, industrial plants, dams, nuclear power plants, high-rise buildings in conditions of dense surrounding buildings and many other objects of this level of complexity), is quite real situation when the costs of reconstruction or liquidation of objects actually turn out to be higher than the received effects from exploitation.

Now in the overwhelming majority of cases, engineering and technological studies of liquidation processes are conducted in the already existing conditions and constraints and proceeding from the acceptable organization and technology of the work. The technology of dismantling and demolition has changed very little in practice over the past decades, the main technical tools remain a bulldozer, small mechanization and manual labor. For large monolithic reinforced concrete structures, the most common method of dismantling is directional explosion, far from technological perfection and dangerous for neighboring buildings and the environment. The demolished building is almost completely transformed into so-called "production waste" and returns to nature in this form. Developments in the field of secondary use and materials and structures of the demolished building are extremely rarely implemented in practice. In the investment and construction complex, organizational and technological, socio-economic and environmental problems in the field of object liquidation have been accumulating for decades and now require systematic scientific and practical research.

3. The main part

In this connection, the organizational and technological transition of the construction industry to the closed system of the life cycle of the construction object, in which the resource cycles of construction are likened to the natural cycles of matter in the ecosphere, is becoming a top priority for the very near future. Modern building technologies, structures and materials have sufficient potential to approach this goal to the maximum extent achievable. The goals of the system and the optimal result, to which it makes sense to strive, is to develop a closed life cycle of the building in resources and energy with the full use of materials and raw materials in subsequent construction and technological cycles.

Solving the problems of liquidation obsolete buildings and other construction projects at the level of modern information and organizational and technological capabilities requires the amplification of a conceptual stage of design by forecasting the final stages of the life cycle of buildings and structures.

Methodologically competent forecasting of liquidation stage includes two directions of analysis and justification:

1. Engineering - ensuring the liquidation processability of a building or other object of construction;
2. Organizational and economic - planning of the complete life cycle of the facility, taking into account and including the liquidation costs in the calculation of the effectiveness and viability of the project.

The adaptability of a building or other construction object to transformations and processability of its liquidation is determined by the totality of the volumetric-constructive and technological properties of the design decisions characterizing the conformity of the objects to the requirements of the construction work for their dismantling, disassembly, removal and disposal. At early stages of design the following should be:

- The most probable terms of the moral and physical aging of the structural and engineering subsystems of the building are analyzed;
- Identified the projected tasks of modernization, reconstruction and liquidation;
- Organizational and technological solutions, corresponding to the tasks of reconstruction and liquidation are justified and provided for in the project.

Synthesis of studies on the demolition of buildings and structures and the ecology of these processes made it possible to determine the directions for solving the problems of liquidation in construction. On this basis, the most effective organizational and technological methods for ensuring the adaptability of construction objects to transformations and the stage of liquidation were identified and systematized.

A system of methods is proposed that includes (Figure 1):

1. the development of organization and technologies for liquidation in the early stages of design.

Here it is necessary to allocate perspective toolkit:

- justification and development of the space-planning and design solutions for the processability of dismantling. The dismantling processability is laid in the project through expert analysis, development and planning in the project of those project parameters that have the greatest impact on the organization and technology of construction. The structures and engineering subsystems of the projected building are analyzed and processed from the standpoint of the convenience of transformations (installation, repair, modernization, dismantling and disposal of dismantled elements);
- analysis and minimization of resource use in project solutions;
- justification of the duration of the stages of the life cycle of the project and the use of materials, elements and structures of the relevant durability in the project.

2. Development of organizational and technological aspects of utilization of dismantled buildings, including the secondary use of materials and their return to nature in its original form. Here we will outline the following promising approaches:

- minimization of the use of composite materials in the project, if there are no acceptable technologies for their decomposition;
- use in the design of structures from recyclable and renewable materials;
- search and development of methods and technologies for the use of secondary resources in construction and other industries
- designing cycles of recycling of secondary raw materials (recycling - processing of garbage, obtaining useful energy throughout the cycle, manufacturing of cleaning equipment, etc.).

3. Designing of the organization and technologies of reclamation, which compensate the consequences of man-caused contamination of the land plot from the previous construction.

The application of these methods and tools to justify the choice of design solutions extends the possibilities of transformations, changes and development of each engineering subsystem of a building. In general, the system of organizational and technological methods for forecasting liquidation increases the adaptive resource of the building during its life cycle. Adaptation resource is

increasing due to minimization of reorganizations in engineering and space-planning subsystems of the building during modernization, renewal of technologies, changing of the functional purpose of the areas and caused by this change in requirements for architectural and constructive, engineering and technological solutions of a building or structure.

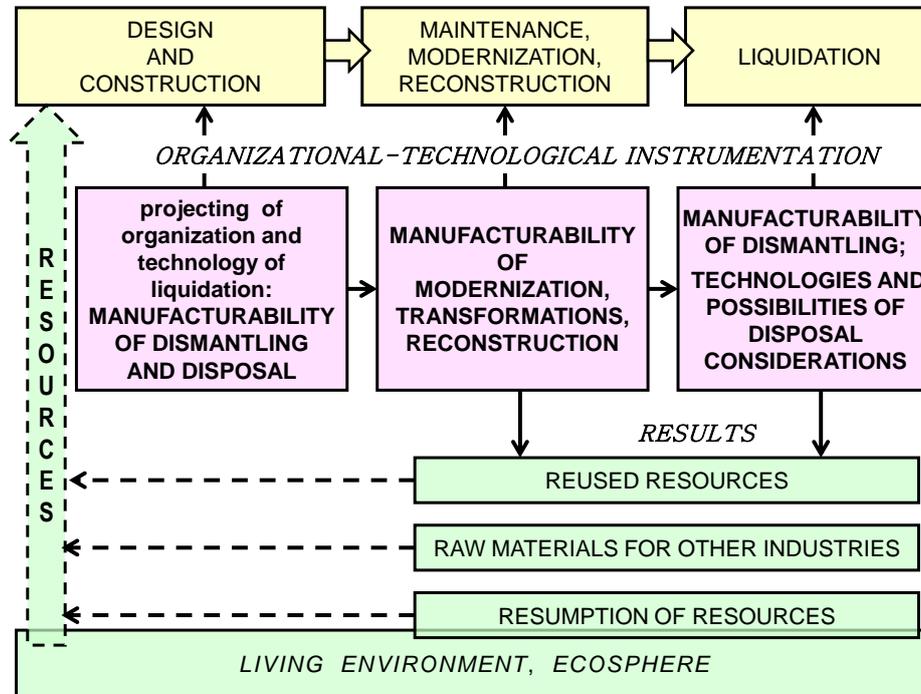


Figure 1. Organizational and technological methods for predicting liquidation in the life cycle of a construction project

4. Discussion

Considering the economic aspects of the analysis and justification of the costs of liquidation and the impact of long-term and uncertainty factors on the problems of planning the complete life cycle of a building as a building object, a number of important accents must be highlighted. Feasibility studies in construction generally do not include analysis of liquidation costs. At the same time, in accordance with international quality standards and environmental management, such an analysis is the norm for many industries and types of products, including automobile manufacturing, the production of large household appliances and others. In the investment and construction sphere, only design and construction costs are analyzed, and economic effects are determined for the customer and contractor in terms of indicators of the first years of operation of the facility and before the first major repairs. This approach is understandable, relatively accurate in calculations and convenient in the current planning. But it is very limited in strategic planning. The limited nature of this approach in conditions of constant acceleration of changes in the conditions and priorities of the real estate market leads to decisions that are imperfect from the point of view of strategic development and the ecosystem as a whole. Many objects built by commercial real estate development in the 2000s, on the rise of the real estate market, are morally very quickly obsolete from the point of view of the functional and design solutions applied there. They have practically no prospects for development in conditions of glut of the real estate market. The retrospective of development and the genesis of many long maintained areas of dense urban and industrial development shows that, given the current scale of the impact of construction on the environment, we satisfy our investment and construction needs and commercial interests, ultimately due to the irreversible deterioration in the quality of life of future generations.

Today it is already obvious and clear to the majority that the development area is not only a place for realizing commercial projects in real estate, but also to a much greater extent the common space of vital activity. In this context, there are two scenarios for further development:

1. either the goals and interests of the participants in the life cycle of a building or structure develop predictably and controllably in the direction of integrating mentality on the basis of ecosystem thinking,
2. or the realization of group professional and commercial selfish interests will lead to further extensive construction, disorganizing and complicating public life support systems.

As a result, we can no longer ignore the long-term consequences of our own activities in calculating the effectiveness and viability of modern projects. Moreover, if we choose a managed development scenario, we must predict and evaluate the likely reactions of natural and socio-economic systems, adjusting the goals, directions and scale of investment in construction. Consequently, economic comparison of effects and costs should include, among others:

- Analysis and evaluation of the resumption of the use of resources (in what way, by whose forces and at whose expense will the renewal take place;
- Assessment of the costs of reclamation of lands damaged and polluted by construction and other technogenic activities.

The analysis of the liquidation phase and the inclusion of relevant costs as an obligatory component of the cost of investment-building projects corresponds to the principle of comparison "with the project" and "without a project" in assessing the effectiveness of investments. Accordingly, valid conclusions about the viability of the project and its right to implementation can be made only on condition that the effect of the operation of the building exceeds the costs of design, erection and liquidation.

In practice, the implementation of the concept of designing an ecologically closed liquidation cycle of a building or other construction object may include additional and costly measures. At the same time, the experience of successful and cost-effective development projects convincingly demonstrates that the effectiveness of investment and construction projects is determined not only by the time value of money and taking into account the production and economic factors, but also due consideration of the socio-environmental factors and effects of the project.

5. Conclusions

Thus, the efficiency of the construction project should be based on the ecosystem understanding of its viability and be evaluated taking into account the interaction of construction production with the ecosystem as the only and non-renewable source and resource of life support for society. The concept of designing a complete and ecologically closed life cycle of a real estate object includes the design of processability of liquidation for engineering and construction solutions and forecasting the liquidation costs in calculating the efficiency and viability of the project. Closed life cycle as a goal and priority of design provides both engineering protection of the environment and the environmentally correct use of natural systems, as well as the intensification of the use of already built buildings, i.e. existing fixed assets.

The volume of traditional extensive construction, and, associated with it, environmental pollution has increased exponentially in recent years. In contrast, the development and application of closed-cycle construction methods lead capital construction to a new level of targeted project priorities and an environmentally safe industry. The development of applied research in this area will make it possible to transform investment and construction activities from resource consuming to resources reproduction and to bring it to a new level of environmental safety and sustainable equilibrium of built-up areas and the environment.

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