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Systems Approach to Technical Expertise

Construction of Buildings and Facilities

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Abstract

On the basis of analyzing the causes of accidents construction of buildings and structures are typical causes typical for almost all collapses. The building construction (structure) is considered as a complex system with all the characteristic features: the presence of subsystems (elements), connection pooling, as well as the condition of integrity functioning. The basic stages of the technical expertise of the condition of building structures, including preliminary inspection, overall and detailed survey. Indicates that from a position of a systematic approach to prevent accidents should be a technical survey not only the status of each item individually, but the entire building structure as a whole; endeavor describe each element is per se and taking into account its place as a whole.

Keywords: technical expertise, inspection of buildings, security, collapse, building construction, system approach

Introduction

The survey of the technical condition of the building structures *is a separate area of construction activities*, covering a range of issues, related to the creating normal working conditions and livelihoods and ensuring operational reliability in the buildings, the development of project documentation for reconstruction of build-

ings and structures. A long-term recurrence of accidents with the same reasons indicates the need to examine the factors leading to the crash and the collapse of buildings and structures; the need for their in-depth analysis, systematization and the efficiency of existing safety management system. There is a relevance of systemic research in solving problems related to the safety of constructions and structures.

Analysis of the causes of accidents in buildings

The analysis of the risks and causes of accidents in industrial buildings and facilities shows that, in general, they occur in buildings that were not previously exposed to survey the technical condition and expertise of industrial safety, or non-compliance with terms of the next expertise. In this regard, the problem of the prevention of accidents acquires particular importance building structures and the validity of the choice of complex engineering measures to prevent them. Control (expertise) technical condition of bearing structures must be systematic and based on the procedures for identifying corresponding to the actual strength, rigidity and stability of structural elements of the regulatory requirements. The cases of the accident are also associated with:

- lack of operating instructions, remodeling and repair of structural concrete building-specific and conditions of use of the building;
- rejection of minor works (insulation, waterproofing, anti-corrosion coating) and a sharp decline in their quality;
- illiterate misuse bearing structures;
- illiterate strengthening of bearing structures;
- incompleteness of the project, working and technical documentation (the original drawings, the results of surveys and calculations) to the object;
- weathering, not envisaged by the project;
- stop facility without proper conservation;
- lack of protection and plundering of the object (and as a consequence, damage to load-bearing structures);
- untimely detection of violations during construction.

Insufficient and superficial analysis of the causes of accomplished tragedies often leads to replication errors of design, construction and operation. The big problem is the fact that most businesses prefer to keep information confidential. This makes it impossible to collect all the information for the conduct of official statistics, analysis of the real causes of major accidents and decision-making to prevent them.

Systematic approach to the diagnosis of the condition of buildings

For effective diagnosis of the condition of industrial buildings turn to a systems approach [1...3]. In studies of complex building structures it is integrated (meaning a record of all relationships, the study of individual structural parts, identi-

fying the role of each of them in the overall functioning of the system and on the contrary, identifying the impact of the whole system on its separate elements). The object of survey (construction or building) is regarded as a complex system with all the necessary features: the presence of the subsystems (elements), connection pooling, as well as the condition of integrity operation. Therefore during the survey it is necessary to identify and evaluate the interaction of all of its parts and combine them. A systematic approach allows reducing or even eliminating the specific uncertainty for the studied issue, reconstructing it in the models that match the objectives of the study; identifying objects, properties, and communications of studied systems, taking into account the mutual influence of the environment. In complex systems, which include building frames, parts (sub) systems are so strongly interrelated set of forward and backward linkages that changing one of them often leads to significant changes in other parts [4...6]. There arises a need to assess and analyze the system as a whole, that is, with the system approach (each element is not described as such, but in view of its place as a whole). In studies of complex systems, this approach is:

- focus on the structural integrity of the object;
- the interdependence of parts of the object, working for the same goal;
- orientation control (analysis) on the final results of operations in a rapidly changing environment.

This approach allows you to understand the relationship between the individual facts and at a higher level to carry out the survey.

And from the point of view of the theory of systems, destruction of any system (building construction) can be considered as a disaster-related homeostasis. The index of homeostasis of system is its internal security (ability of a system in internal and external influences maintain its normal operation). The system continues to function, because it contains a lot of additional resources to ensure sustainability. Her work can be seen as continuously changing combination of failure and recovery elements of the structure. When there are notable global failures and several small individually harmless failures are combined, it becomes possible global system failure (occurs as a consequence of a combination of multiple errors). Each of these failures can cause an accident, but together they achieve results. And there is no only one cause of the accident and it is impossible to determine its root cause. Really conformity assessment is usually carried out by comparing the characteristics (parameters) of the building available to the project documentation, with the same characteristics obtained as a result of the survey. But the question of what specific parameters should be compared at the discretion of professionals engaged in survey of the building or structure (some experts at the operational controls are compared, for example, 20 parameters, and others - 25, and possibly completely different). It is from this perspective, a retrospective analysis of accidents, especially according to expert estimates, is biased (technical misunderstanding of the nature of the failure makes it easy to find the culprit accident).

The expertise of technical condition and reliability of operating buildings using design standards is highly conditional and limited. As practice shows, the real

value of the risk to a functional state separate structure or the entire structure is much higher than predicted on the basis of limit state criteria. Consequently, resource of building structure can only be regarded as a random quantity that depends on the random variable initial load capacity of the structure and intensity of changes in its specific operating conditions. The task of assessing the state of structures can be solved correctly only using the methods of reliability theory (in a probabilistic formulation). In fact, the work of building structures depends on many random factors: load, inhomogeneity of the material structure, taking into account geometrical dimensions and tolerances, and other potential inaccuracies. Under the influence of load, ambient, adverse conditions structural damage accumulates, the bearing capacity of the system is reduced, increases the probability of failure of one or more parameters. All of them, both singly and together, with almost equal probability could lead to an accident. Predict what the reason is basically not possible, since a change in any element of the building structure has an impact on other elements and it leads to a change of the whole system. When vital parameters are close to the limit value (or negative factors exceeds some critical value), the continued existence of the building structure will be at risk, and the future of the system becomes unpredictable (in particular, under the influence of the slightest fluctuations construction can collapse).

Expertise of technical condition of buildings

All the negative factors leading to the accident and the collapse of the building, should be identified not after, but before the accident, as part of the expertise of the safety of buildings and structures, which should include:

- verification of compliance of building constructions and facilities design and scientific and technical documentation;
- expertise of the technical condition of constructions and structures for the detection of defects and damages, attitude, actual cross sections and collapsing connections;
- determination of the physical properties of materials, metallographic and chemical composition of the materials analyses from which the data are constructed buildings and facilities;
- strength calculations and other work to assess the stress-strain state and the remaining service life of structures.

In general, the whole complex of works on expertise of technical condition of the building is to examine the technical documentation and field survey, and usually consists of:

- preliminary inspection (determination of volume and value of works);
- general inspection (assessment of the overall technical condition of constructions and engineering systems, conducted by external signs; recommendations for correcting defects in the repair or reconstruction);
- detailed survey (in-depth sample survey; perform without fail in the absence of working drawings of structures or their non-conformity to the design data, the calculation of the elements of the building, the analysis of the survey results).

Conclusion

We shall emphasize in addition that collapse does not occur specifically because of one of the failed element, mainly due to the shutdown of its overall system designs (building structure begins to work as a mechanism). Therefore, to prevent accidents should use systematic approach, that is, to carry out technical expertise of not only the state of each element separately, but the entire building structure in general [1, 2, 5].

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