Systematization of organizational and technological aspects of scientific technical support of buildings and constructions over 100m high

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Abstract. Due to necessity to improve the efficiency of the projected construction of increased complexity, this item considers the possibility of systematization of organizational and technological aspects of the scientific and technical support of buildings and constructions with a height of more than 100m. After analyzing the existing regulatory documentation, an algorithm was proposing that would systematize and form the organizational and technological aspects of the scientific and technical support of design and construction. Optimization of the comprehensive analysis of the effect of multiple options and their combinations will improve the efficiency and safety of the building and reduce the service life.

1. Introduction

In modern conditions, more and more attention is paid to improving the efficiency and safety of the designed construction subject. When construction affects unique buildings that have an increased level of responsibility, quality assurance is carry out through the scientific and technical support of the design (STSD) and construction.

The scientific and technical support of design understood as a complex of scientific, methodological, expert control, information, analytical, organizational and legal-nature to ensure quality and safety in the design, construction and subsequent operation of buildings and constructions [7].

2. Materials and methods

The method of theoretical analysis was using as the main research method. In this case, the materials for the study used technical standards in the design and construction of high-rise buildings and structures. Types of large-span, high-altitude and other unique buildings and constructions defined by the Town Planning Law book of the Russian Federation (Chapter 6 Article 48.1 «Especially dangerous, technically complex and unique subjects”). High-rise buildings and constructions are buildings and constructions with a height of more than 100 m. Scientific and technical support of such buildings and constructions should be carry out already at the stage of issuing a task for engineering surveys. Paragraph 4.15 of the set of rules 22.13330.2011 “Foundations of buildings and structures” states: The scope of work on the scientific and technical support of engineering surveys, design and construction of foundations, foundations and the underground parts of the structures should be determined by the general designer and agreed upon by the construction customer.”

Until today, determine the following types of STSD [9]:
− Regulatory support;
− The optimal choice of design;
− Mathematical and physical modeling;
− Analysis of the possibility of using new construction materials;
− Development of process regulations;
− Examination of design solutions.

Some participants in the construction industry believe that the existing quality control system of design and construction, which was establishing many years ago, at the stage of development of a modern investment and construction complex cannot ensure the implementation of fundamentally new and increased quality requirements due to the lack of the necessary organizational and technical base among construction participants. A system that is bas mainly on control methods, not aimed at providing a comprehensive analysis of the results of production and laboratory tests, inspections and studies, cannot guarantee the quality of construction that corresponding to new requirements. On the other hand, it should be not that the task of scientific and technical support does not include duplication of existing forms of control, but only their effective addition using special tools, laboratory and instrumental studies, the generalization of experience for subsequent use and complete control of the application of technical innovations.

Scientific and technical support for the design of unique buildings and constructions and existing recommendations are two directions focused on achieving a single result and complement each other. By the result meant the finished object of the corresponding functional purpose, which meets modern requirements of efficiency and safety during the entire period of operation.

Today, the construction industry has the following requirements for underground and aboveground parts at designing buildings and structures with a height of more than 100m:
1. Residential high-rise buildings should be attributed to 1 level of responsibility, according to code of practice (CP) 2.01.07-85 [7]. In this regard, the reliability coefficient for responsibility is assumed to be 1.1 - for buildings over 75 m to 100 m, 1.15- over 100 m to 125 m and 1.2 - over 125 m to 150 m;
2. According to CP 2.01.07-85 [7] and the experience of residential [8] high-rise construction buildings abroad the horizontal movement of the top of a high-rise building should be equal to not more than 1/500 of its height. Since in this case the building works satisfactorily under the action of wind load, preserves the integrity of partitions and glazing, and maintains normal living conditions. To this end, according to foreign experience [8], it is recommended to take the ratio of the smaller building in terms of its height to no more than 1/7;
3. Calculation of high-rise buildings on the vertical, horizontal from the wind, including the average and pulsating components, temperature types of loads;
4. Comprehensive assessment of the bearing capacity of the soil, taking into account the specifics of the designed building type;
5. Necessity to take into account the effects arising from the local destruction of the supporting structures of buildings and leading to the progressive destruction of its constructions;
6. Providing rational volume-spatial, constructive and planning decisions.

3. Results
During the analysis, the following main features of the design of high-rise buildings and structures were identifying (Table 1).
Table 1. The main features of the design of high-rise buildings and structures.

| №  | Name of parameter groups | Features of parameters                                                                                                                                                                                                                           |
|----|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Design parameters        | - Increasing, depending on the height, the reliability coefficient of responsibility - from 1.0 to 1.2 [2];  
- mandatory verification of the seismic resistance of high-rise buildings and structures [1];  
- When calculating buildings for wind loads, one should additionally take into account the average and pulsating components of the calculated wind load, impacts that cause disturbances in the comfort of pedestrian areas [2];  
- testing of models in wind tunnels;  
- conducting engineering and geological surveys again at the design and working stages;  
- development of the forecast of the impact of the building under construction on the surrounding buildings and the hydrogeological regime of groundwater;  
- increased requirements for concrete preparation;  
- increased requirements for the design of the foundation and consideration of soil conditions [7, 10]. |
| 2  | Organizational parameters| - determination of optimal solutions for the sequence, methods of construction and facilities;  
- it is necessary to provide premises of the following purpose:  
- for placement of technological equipment of the Ministry of Internal Affairs (SOS and SES);  
- for a stationary station monitoring the load-bearing structures of the building and the equipment room [2];  
- for the central control point of the building security systems;  
- fire protection;  
- Engineering systems of the building [2].  
- Surveys, design and construction of high-rise buildings with a height of 100 m and more should be caring out as part of work on the NTS by the relevant scientific organizations in accordance with SP 22.13330 [2]. |
| 3  | Technological parameters | - Improving the reliability and efficiency of technology installation [9];  
- the use of more efficient materials;  
- the choice of lifting devices, taking into account all the decisions and requirements;  
- binding of mechanized devices by a single control system, to exclude the possibility of contact of cranes or cargoes; |

Analysis of the scientific and technical literature has shown that previous studies in the design of unique buildings and structures do not fully describe the requirements for the program of scientific and technical support referred to in the Urban Development Code and the existing sets of rules in the Russian Federation [2, 7, and 11]. In addition, there is no information about the specialized organization that should carry out the NTS [2]. Including there are no clearly defined organizational and technological criteria for scientific and technical support for the design of buildings and structures with a height of more than 100 m. It is important to understand that NTSC unique buildings and structures and existing recommendations are two areas focused on achieving a single result - the finished object of the corresponding functional purpose, which meets all modern requirements of efficiency and safety during the entire period of operation.
Figure 1. Algorithm for systematization of organizational and technological aspects of scientific and technical support of buildings and constructions with a height of more than 100 m.
This article discusses a simplified algorithm for the formation of organizational and technological aspects of the scientific and technical support of buildings and structures more than 100 m high, which can be enlarge in three stages (Fig. 1). The first stage is aim at studying the existing requirements, recommendations and special technical conditions containing additional to the established or missing technical requirements in the field of safety, reflecting the features of engineering surveys, design, construction, operation, when designing buildings and structures more than 100 m high. At the second stage, it is plan to develop a comprehensive program of scientific research and the creation of a scientific and technical base, including the implementation of fundamental, exploratory, leading to issue-oriented and applied research. In addition, the creation of scientific, technical and technological recommendations for further analysis of the results. The third stage is aimed at developing, starting from the design stage, technical and technological solutions that will be innovations, and not modernization. Creating a scientific and technical base aimed at maximizing the use of all resources: scientific potential, laboratory tests, existing recommendations.

4. Conclusion
After a study for systematization of the organizational and technological aspects of STSD, this item offers consideration of the following direction of the composition of the scientific and technical support of design:
1. Prediction of the state of a building, structure with various types of impact on the construction or its individual nodes;
2. Development of measures and control of elimination of deficiencies, violations identified during the monitoring of design decisions taken in the work;
3. Development of a program of monitoring responsible structures;
4. Development of technical recommendations which were not included in the current regulations;
5. Participation in the development of new, unique solutions for creating a project of future construction;
6. Development of additions to the project documentation of the unique under construction subject.

Formation of aspects of scientific and technical support, which is intend both for designers and for government agencies and investors, will improve the efficiency and optimize the construction process at each stage of the object’s life cycle. NTSC is the direction that needs to be implement and only the integrated use of it by all participants in the construction process will ensure the efficiency and safety of the construction project. At the next stage, it is plan to develop the program of the scientific and technical equipment.

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