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Comprehensive Assessment of the Quality of Construction Works using Information Technology

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Abstract: The article deals with a comprehensive assessment of the quality of construction work using information technology. Quality control of construction products is considered to be checking the compliance of product quality indicators with established requirements, which are recorded in the project, standards and technical conditions, supply contracts, product passports and other documents.

Keywords: quality control, general construction works, mathematical modeling, BIM, construction works classifier.

The main factor affecting the cost of construction, efficiency and durability of constructed buildings and structures is the quality of construction products. To ensure the required level of quality, it is necessary to carry out control, the untimeliness and incompleteness of which leads to an increase in the cost of construction, an increase in operating costs to maintain the required technical condition of the constructed facility and, in the worst case scenario, to accidents.

Quality control of construction products is considered to be checking the compliance of product quality indicators with established requirements, which are recorded in the project, standards and technical conditions, supply contracts, product passports and other documents.

SP 48.13330.2011 "Organization of Construction" establishes that participants in the construction process must control the quality of products arriving at the construction site, the compliance of construction and installation works with the declared technologies and standards, and everything that determines the quality of the finished object. The process of organizing quality control at a construction site, its structure, methods of implementation that provide optimal material and legal support for construction work are described in the Recommendations for the creation of quality systems in construction and installation organizations.

The quality of the constructed construction object is affected by the quality of each work performed at the construction stage. Due to the wide variety of construction and installation works, control over each of the stages is carried out with its own characteristics, which is detailed in the manual “Technology and organization of construction” by Sokolov G. K.

Despite the fact that the work of many scientists is devoted to the issue of quality control, a large number of unresolved problems remain:

1. Loss of design information:

- 30% of information is lost when transferring data to the construction site;

2. Lack of document version control:

- 40% of construction companies use paper drawings;
- 35% of all construction projects undergo significant changes during the construction phase;

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3. Insufficient coordination at the construction site and slow resolution of issues:

- 47% of builders do not use automated technologies.

In this connection, there is a need to introduce automated technologies that have a link with 4D and 5D level BIM at the stage of quality control of construction work, which will remain relevant for a long time. The use of information technology will help to successfully organize construction, significantly reduce human labor costs and transfer information from paper to the digital environment. Tools have already been developed that allow us to bring construction control to a new level, thereby allowing us to accurately and quickly assess the situation at the construction site:

- ✓ Autodesk BIM 360 Field
- ✓ Master Lock FieldID (CAN)
- ✓ SnagR (UK)
- ✓ StroyControl (RUS)
- ✓ LEMENT PRO (RUS)
- ✓ NEOSYNTEZ (RUS)
- ✓ Aconex Construction
- ✓ Plangrid (USA)
- ✓ LATISTA (USA)
- ✓ GenieBelt (DEN)
- ✓ Etton (RUS)

These software products make it possible to simplify the work of construction control specialists, but do not allow a comprehensive assessment of the quality of the work performed.

The purpose of this work is to develop a mathematical model that allows for a comprehensive assessment of the quality control of civil works.

In order to achieve this goal, it is necessary to solve a number of tasks:

1) to develop a mathematical model that makes it possible to give a comprehensive assessment of the quality of general construction works;
2) consider the process of quality control of civil works using automated technologies.

Comprehensive assessment of the quality of civil works.

In order to obtain a comprehensive assessment of the quality of civil works, it is necessary to develop a mathematical model that allows you to evaluate the quality of each of the works separately and then come to the final comprehensive assessment of each type of work. To do this, we turn to the complex method of qualimetry.

Qualimetry is a scientific discipline within which questions of quantitative measurement of the quality of objects and processes are studied.

The complex method of qualimetry assumes different importance of the grouped indicators, which is taken into account in the values of the corresponding weight coefficients. Let us develop a hierarchical structure of the system of indicators of the quality of general construction works. (Fig. 1).

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A comprehensive assessment of the quality of general construction works K is calculated by the formula:

$$K=\sum_{i=1}^{n} Ki * ai$$

$$i=1, 2, \ldots, n;$$

where K_i is the i-th key indicator for assessing the quality of the work performed; a_i is a weighting coefficient that determines the degree of influence of the quality of the work performed on the comprehensive assessment of the type of work.

$$K_i = \sum_{j=1}^{m_j} K_{ij} \cdot b_j;$$
$$j = 1, 2, \ldots, m_j;$$

The key quality indicator K_i is calculated by the formula: a coefficient that determines the degree of influence of the quality of the work performed on a comprehensive assessment of the type of work.

Key quality indicator K_i is calculated by the formula:

$$K_i = \sum_{j=1}^{m_j} K_{ij} \cdot b_j;$$
$$j = 1, 2, \ldots, m_j;$$

where K_{ij} is a partial indicator of the quality of the controlled parameter; b_j is a weighting factor that determines the degree of influence of the quality of the controlled parameter on the key indicator.

$$K_{ij} = \frac{q_{ij} - q_{ij}^{worst}}{q_{ij}^{best} - q_{ij}^{worst}},$$

K=1 - determines the identity of the researched and reference works;

K>1 - indicates that the study work is better than the reference work;

K<1 - indicates that the work under study was performed with deviations from the reference work.

The process of quality control of general construction works using information modeling technologies.

The processes taking place at the 3D, 4D, 5D levels are tightly connected: information on volumes and materials (3D), supported by information on the time frame for the execution of work (4D), then, as a result of the construction work and their quality control, acts are drawn up on the acceptance of completed contract construction - installation works (KS-2) and a certificate of the cost of work performed and costs - KS-3 (5D).

The resulting mathematical model makes it possible to obtain a comprehensive assessment of the quality of construction work, taking into account the significance of each controlled parameter (partial indicator) for the final assessment. The use of automated technologies makes it possible to obtain the necessary data in a short time and based on reliable information. The use of information modelling technology at the stage of quality control of construction work is one of the effective solutions to improve the efficiency of construction activities.

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