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Discussion on the Inspection Standards of Construction Quality for Office Buildings

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Abstract: This paper introduces the relevant content of construction quality inspection standards for office buildings, including their differences and special requirements of general buildings. It elaborates on the application of BIM technology and the PDCA cycle model in each stage of construction, emphasizes the importance of technical management system construction, and also discusses the influence and optimization path of prefabricated buildings and LEED certification on the standards.

Keywords: Office building; Construction quality; Inspection standard

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1. Introduction

In the context of the development of the construction industry, the construction quality inspection standards for office building projects cover core elements such as the quality of the project entity, material quality, and construction process standardization. The particularity of office buildings requires unique requirements in terms of structural safety, fire protection systems, and intelligent configuration, which require targeted analysis. During the construction phase, it is extremely important to implement inspection standards by combining BIM technology, the PDCA cycle model, and a technical management system. BIM technology assists in full lifecycle management, the PDCA cycle promotes continuous quality improvement, and the technical management system provides standardized operating procedures and quality control basis. At the same time, the standardization of the engineering planning stage lays the foundation for optimizing inspection standards, clarifying quality objectives and inspection points, providing guidance for quality control in the construction process, and ensuring high-quality delivery of office building projects.

2. Basic theory of quality inspection standards for office building construction projects

2.1. Definition and classification of construction quality inspection standards

The construction quality inspection standard is a technical document that specifies the characteristics and indicators

of construction quality, used to measure whether the construction quality meets the requirements. It covers all aspects of engineering construction, including the quality of materials, components, equipment, construction technology, quality control during the construction process, and acceptance after project completion. From a hierarchical perspective, it can be divided into national standards, industry standards, and enterprise standards. National standards are authoritative and mandatory standards formulated by relevant national departments, and are the basic requirements that must be met for the quality of construction projects. Industry standards are standards developed by industry associations or organizations, which supplement and refine national norms and are more targeted and professional. Enterprise standards are standards formulated by enterprises based on their own technical level and management requirements, usually stricter than national norms and industry standards, and are an important means for enterprises to improve their competitiveness [1].

2.2. Special requirements for office building engineering

As a specific type of building, office buildings have their own particularities compared to residential and industrial park factories, which determine their unique requirements for construction quality inspection standards. In terms of structural safety, office buildings often have more floors and carry heavier personnel and equipment, requiring higher strength and stability of the foundation and main structure [2]. The fire protection system plays a crucial role in office buildings. Due to the high density of personnel and the numerous office equipment, there are significant fire hazards. Therefore, the quality standards for the provision of fire protection facilities, fire separation, evacuation routes, and other aspects are more stringent. Intelligent configuration is also an important feature of office buildings, which needs to meet the needs of efficient office work, including quality inspection standards for intelligent security, intelligent lighting, intelligent communication, and other systems. The special requirements of these office building projects require the development of targeted standards during construction quality inspection.

3. Specific applications of inspection standards in the construction phase

3.1. Standard execution in the dimension of technical management

The application of BIM technology is extremely important for the implementation of inspection standards during the construction phase [3]. In terms of concealed engineering acceptance, utilizing the visualization characteristics of BIM technology, virtual modeling and analysis of concealed engineering can be carried out before construction, and the acceptance points and standards can be determined in advance. During the construction process, strict adherence to standard procedures is required, such as pipeline laying and cable embedding for concealed works. After completing the corresponding construction stages, timely acceptance checks are conducted against BIM models and established standards. For material quality testing, it is necessary to conduct a comprehensive evaluation using advanced testing equipment and technology in accordance with relevant standards. When materials enter the site, not only should their strength be tested, but also their specifications, performance, durability, and other indicators should be checked to ensure compliance with engineering requirements. BIM technology can be used for material information management by establishing a material database to record information such as material sources, specifications, and testing reports, achieving traceability and management of the entire life cycle of materials. At the same time, BIM models can be associated with detection data to update material status in real-time, providing data support for construction quality control and ensuring the construction quality of office building projects.

3.2. Integration of quality control in progress management

During the construction phase, the collaborative management of the construction schedule and quality inspection

nodes is achieved through the PDCA cycle model [4]. In the planning (Plan) phase, a detailed construction schedule plan including quality inspection nodes is developed based on the characteristics of the office building project, clarifying the quality objectives and inspection standards for each stage. During the implementation (Do) phase, strictly follow the construction plan and carry out quality inspection work synchronously to ensure that the quality of each inspection node meets the standards. During the checking (Check) phase, compare the quality of actual progress with planned goals and promptly identify deviations. In the action (Act) phase, adjustment measures are taken to analyze the reasons for deviations, such as rectifying parts that do not meet quality standards, optimizing subsequent construction schedules and quality inspection node arrangements, and achieving dynamic integration and continuous improvement of schedule management and quality control.

4. Impact mechanisms of technical management on inspection standards

4.1. Construction of the technical management system

4.1.1. Preparation of standardized work instructions

The construction of a technical management system is extremely important in the quality inspection standards for office building construction [5]. It covers all aspects from construction technology to quality control. By establishing a comprehensive technical management system, the responsibilities of each department and personnel are clarified, ensuring the standardization and normalization of the construction process. The preparation of standardized work instructions is a key part. It specifies in detail the various steps and operating standards of construction, providing clear guidance for construction personnel. This helps to reduce human errors during the construction process and improve construction quality. At the same time, the homework manual should be compiled based on the visual disclosure of construction process standards to ensure its close integration with the actual construction process. Visual disclosure of construction process standards plays a core role in quality pre-control, as it enables construction personnel to have a more intuitive understanding of construction requirements and quality standards, thereby better ensuring that construction quality meets inspection standards.

4.1.2. Technological innovation in testing equipment

The construction of a technical management system has a significant impact on inspection standards. Reasonable technical management can ensure the accuracy and reliability of testing equipment, thereby providing strong support for inspection standards. In terms of technological innovation in detection equipment, taking the application of intelligent detection instruments in real-time monitoring of concrete strength as an example, technological innovation has made detection more accurate and efficient. Intelligent detection instruments can obtain real-time concrete strength data, which not only improves detection efficiency but also provides a more accurate data basis for the formulation of inspection standards. By guiding and standardizing the technological innovation of testing equipment through technical management, the inspection standards can be continuously optimized to make them more scientific and reasonable, and meet the actual needs of engineering construction quality [6].

4.2. Adaptation of new technology application standards

4.2.1. Optimization of construction standards for prefabricated buildings

The application of new technologies in prefabricated construction promotes the continuous adaptation and optimization of inspection standards. Taking prefabricated component connections as an example, with the improvement of technical management level, new connection technologies continue to emerge, such as new bolt connections, grouting sleeve connections, etc. [7]. The application of these new technologies requires updating

the existing quality inspection standards. In terms of connection quality inspection, it is necessary to redefine key inspection indicators based on the characteristics of new technologies, such as connection strength, compactness, sealing, etc. At the same time, the inspection methods also need to be updated, which may involve the use of advanced non-destructive testing techniques to more accurately evaluate the quality of the connections. Technical management influences the quality inspection standards for prefabricated building components by promoting the application of new technologies, including inspection indicators and methods, in order to continuously optimize them to meet the development needs of the construction industry.

4.2.2. Upgrade of green construction technology standards

The LEED certification system, as an advanced green building evaluation standard, has a significant impact on the energy-saving and emission reduction testing indicators during the construction process of office buildings. It has promoted the transformation of technical management in terms of inspection standards, and facilitated the adaptation of new technology application standards and the upgrading of green construction technology standards. In terms of the application of new technologies, it is required that the new technologies used in the construction process must comply with the strict requirements of the LEED certification system for energy conservation and emission reduction, ensuring that the application of technologies can effectively improve energy utilization efficiency and reduce pollution emissions [8]. At the same time, the green construction technology standards have also been upgraded accordingly, such as placing more emphasis on environmental performance in material selection, stricter waste management during construction, and more refined energy consumption monitoring, in order to meet the high standard requirements of the LEED certification system for office building construction quality.

5. Integration of inspection standard optimization path and engineering planning

5.1. Standardization prerequisites in the engineering planning phase

5.1.1. Linkage between quality objectives and planning schemes

During the engineering planning phase, emphasis should be placed on standardization as a prerequisite, closely linking quality objectives with the planning scheme [9]. Establishing an engineering quality cost optimization model based on value engineering theory is crucial. In engineering planning, it is necessary to clarify quality objectives based on the characteristics and requirements of office building projects, which should cover multiple aspects such as building structural safety and functional improvement. At the same time, the planning scheme should revolve around quality objectives, from the selection of construction technology, material, and equipment to personnel organization and arrangement, all of which should be guided by ensuring the achievement of quality objectives. For example, in terms of construction technology, mature technology that has been verified through practice and meets relevant standards should be selected; in the selection of materials and equipment, attention should be paid to quality and performance to ensure that they meet the usage needs and quality standards of office buildings. Through this close linkage, standardization is achieved in the engineering planning stage, laying the foundation for optimizing the inspection standards of subsequent construction quality.

5.1.2. Construction of risk warning standard system

Standardization should be prioritized during the engineering planning phase. For the optimization of inspection standards for the construction quality of office buildings, the FMEA method can be used to develop construction quality risk classification and control standards, and to construct a risk warning standard system. By analyzing potential risks that may arise during the construction process, identifying potential failure modes and their

influencing factors, assessing the severity, frequency, and detectability of risks, and determining the risk level. Develop corresponding control measures based on risk levels to effectively prevent and control construction quality risks. At the same time, incorporating these risk control standards and measures into project planning ensures that every aspect of the construction process meets quality requirements, improving the stability and reliability of office building construction quality [10].

5.2. Dynamic adjustment of standards driven by progress

5.2.1. Quality control standards for critical circuits

In terms of integrating engineering planning, it is necessary to incorporate inspection standards into the overall engineering planning process. From the initial stage of the project, set quality objectives and an inspection standard framework based on the characteristics of the office building project. As the project progresses, standards will be dynamically adjusted based on schedule-driven approaches. When the progress of processes on the critical path is advanced or delayed, adjust the frequency and focus of quality inspection accordingly. For the quality control standards of critical routes, it is necessary to determine the key processes. Study the method for determining the strength coefficient of key process quality inspection in network planning technology, and scientifically set the strength coefficient based on factors such as the importance, complexity, and impact on subsequent processes of the process. Reasonably arrange inspection resources based on this coefficient to ensure effective quality control on critical routes and guarantee the overall quality of office building projects.

5.2.2. Quality assurance standards under rush work conditions

In office building construction, inspection standards need to be integrated with project planning and dynamically adjusted according to progress. Quality assurance standards are extremely important in a rush-to-work state. Special clauses for parallel construction quality acceptance should be formulated under the condition of a compressed construction period. This requires a comprehensive consideration of the impact of rush work on various construction stages, and accurate identification and evaluation of potential quality risk points. For example, in areas where multiple job types are working simultaneously, clarify the quality responsibilities and acceptance standards of each job type to avoid the phenomenon of shirking responsibility. At the same time, strengthen the quality control of key processes and concealed works, increase inspection frequency and strictness. In terms of material usage, even during the rush stage, it is necessary to adhere to the quality standards of materials and avoid using unqualified materials due to schedule pressure. By implementing these measures, we ensure that the material quality is always under control, thereby guaranteeing the construction quality of the office building project while rushing to meet the deadline.

5.3. Collaborative innovation of multiple engineering types and standards

5.3.1. Transfer of experience in residential and factory engineering

The improvement plan for steel structure testing standards in office building projects can be considered from multiple aspects. In material testing, advanced technology is borrowed to ensure that the quality of steel meets the high strength and toughness requirements for office building projects. For the inspection of welding parts, based on the experience of factory engineering, various non-destructive testing methods are adopted to ensure the quality of welding, such as combining ultrasonic testing with radiographic testing to improve the accuracy of defect detection. In terms of overall structural stability testing, referring to the large-scale structural testing methods of factories, finite element analysis and other methods are used to simulate the stress situation of office buildings under different load conditions, ensuring the safety and reliability of the structure. Meanwhile, considering the functional characteristics of office buildings, the testing standards for fire prevention, sound insulation, and other

aspects should be optimized based on factory engineering to meet the usage needs of office buildings.

5.3.2. Integration of smart construction site standard system

To achieve the integration of inspection standard optimization path and engineering planning, as well as collaborative innovation of multiple types of engineering standards, it is necessary to construct a unified standard framework for IoT quality monitoring applicable to multi-format engineering. This framework should integrate the characteristics and requirements of different types of engineering, breaking the limitations of traditional standards. Through IoT technology, real-time monitoring and data collection of engineering quality can be achieved, providing an accurate basis for quality assessment. At the same time, it is necessary to closely integrate all aspects of engineering planning with inspection standards to ensure that every step of the construction process meets quality requirements. In terms of integrating the standard system of smart construction sites, advanced technologies such as the Internet of Things, big data, and artificial intelligence should be fully utilized to achieve interconnectivity and intelligent management of construction site information, improve engineering quality and management efficiency, and promote the improvement of construction quality in office buildings.

6. Conclusion

The construction quality inspection standards for office building projects cover multiple core elements. From the perspective of engineering entity quality, it includes indicators such as stability and safety of building structures, as well as aesthetic and practical standards for decoration projects. Material quality inspection is also crucial, ensuring that the materials used comply with relevant specifications. Meanwhile, the standardization and rationality of construction techniques are equally important.

With the development of technology, BIM + 5G technology provides direction for intelligent inspection standards. Real-time and accurate quality monitoring and data transmission can be achieved through the visualization model of BIM and high-speed transmission of 5G.

Standard pre-control during the engineering planning phase is of great significance for quality management throughout the entire lifecycle. It can plan quality objectives and control measures in advance, avoid quality problems during the construction process, ensure that office building projects meet high-quality requirements from start to delivery, and improve the overall quality level of the project.

Disclosure statement

The author declares no conflict of interest.

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