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Research on the Application of Architectural Decoration Technology Management in Housing Construction Projects

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Abstract: The management of architectural decoration and renovation technology encompasses multiple aspects, including the implementation of design standards, process flow control, and material quality monitoring. Housing construction projects have specific requirements, such as cross-construction, finishing treatment, and finished product protection. The text also introduces BIM deepening design and modular installation techniques. It emphasizes the importance of material management, quality control, and the PDCA cycle, as well as various specialized inspections, smart site management, and mobile terminal applications. Intelligent management is seen as the future direction.

Keywords: Building decoration and renovation; Technical management; Housing construction engineering

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1. Introduction

Architectural decoration and renovation technology management is a key link in building construction projects, covering various aspects such as design standard execution, process control, and material quality monitoring. In recent years, with the continuous improvement of relevant policies in the construction industry, such as the "Guiding Opinions on Promoting High quality Development of the Building Decoration and Renovation Industry" released in 2020, it emphasizes the importance of strengthening technical management to improve project quality. In this context, this article will delve into various dimensions of architectural decoration and renovation technology management, including the special requirements of building engineering decoration and renovation, BIM deepening design and modular installation technology, material management system process control, quality control benchmark construction, PDCA cycle application, concealed engineering quality management, special testing, smart construction site management system architecture, mobile terminal application scenario development, environmental monitoring system application, as well as IoT technology and intelligent construction equipment application, aiming to provide theoretical support and practical guidance for improving the level of architectural decoration and renovation technology management.

2. Theoretical basis of technical management in decoration and renovation engineering

2.1. The core connotation of architectural decoration and renovation technology management

The core connotation of architectural decoration and renovation technology management involves multiple aspects [1]. The implementation of design standards is crucial, and it is necessary to strictly follow relevant specifications and standards to ensure the scientificity and rationality of the design scheme, and meet the functional and aesthetic needs of the building. Process control is equally important, covering the operation standards from construction preparation to each process, ensuring the orderly progress and stable quality of construction. The quality monitoring of materials cannot be ignored. Strict control should be exercised over the selection, procurement, and inspection of materials to ensure that they meet quality requirements. This is the foundation for ensuring the quality of decoration and renovation projects. By effectively managing the execution of design standards, process control, and material quality monitoring, a full-cycle management model is constructed to achieve efficient operation of building decoration technology management.

2.2. Special requirements for decoration and renovation of building construction projects

The decoration and renovation of building construction projects have certain special requirements [2]. In terms of cross construction in engineering, decoration and renovation projects often intersect with civil engineering, water, and electricity projects, and require coordination of the construction sequence and progress of various trades to avoid mutual interference and delay in the construction period. For the treatment of spatial interface closure, due to the complex internal space of building construction projects and the difficulty of closure at the junctions of different materials, construction personnel are required to have exquisite skills and rich experience to ensure the beauty and quality of closure. In the establishment of a finished product protection system, the finished products of decoration and renovation projects are prone to damage during subsequent construction and use. Therefore, it is necessary to establish a sound finished product protection system, and effective protection measures should be taken from materials, the construction process to maintenance after acceptance to ensure the durability of the decoration and renovation effect.

3. Application analysis of technical management in decoration and renovation engineering

3.1. Technical application in construction organization design

BIM deepening design can optimize node details. By creating a 3D model, the node structure can be presented more intuitively, and any unreasonable aspects in the design can be identified and adjusted in a timely manner to ensure the feasibility and aesthetics of the nodes [3]. Meanwhile, modular installation technology has significant advantages in improving the efficiency of decorative component assembly. Modular design of decorative components according to their functions and specifications, prefabricated production in the factory, and then transported to the site for rapid assembly. This method not only reduces the time and workload of on-site construction, but also improves the installation accuracy and quality of components, ensuring the overall effect of decoration and renovation projects.

3.2. Process control of material management system

The process control of material management system is crucial in building decoration and renovation projects. A full process control standard should be established from material selection demonstration to on-site acceptance, storage, and application [4]. The material selection demonstration needs to comprehensively consider factors such as engineering requirements, performance indicators, and environmental protection requirements. The

on-site acceptance must strictly check the specifications, models, quality certification documents, etc. of the materials to ensure that they meet the design and specification requirements. For storage, suitable environmental conditions should be provided based on material characteristics to prevent material deterioration and damage. In the application process, it is necessary to operate according to established process specifications to ensure that the material's performance is fully utilized. Meanwhile, with the deepening of environmental protection concepts, it is necessary to focus on analyzing the application standards of new environmentally friendly materials, including their special construction process requirements and quality control points, to ensure the quality and environmental performance of decoration and renovation projects.

4. Technical implementation strategy of quality management system

4.1. Construction of quality standards and process control

4.1.1. Establishment of quality control standards

It is crucial to establish quality control benchmarks based on the GB50210 standard [5]. The visual quality standards need to be clear, covering all aspects of decoration and renovation, such as surface smoothness, color consistency, etc., to provide intuitive evaluation criteria for project quality. At the same time, the actual measured technical indicators should be accurately formulated, including specific numerical ranges for size deviation, internal and external angle squareness, etc. These standards and indicators will serve as the cornerstone of quality management, ensuring that there are clear quality requirements to follow at every stage of the building decoration process, thereby effectively ensuring the overall quality of the construction project and enhancing the aesthetics and practicality of the building.

4.1.2. Implementation method of PDCA cycle

The PDCA cycle consists of four stages: Plan, Do, Check, and Act. In the management of architectural decoration technology, taking the control of ceiling flatness as an example, the planning stage needs to determine quality objectives and control standards, analyze factors that may affect flatness, and develop corresponding measures [6]. Strictly follow the construction plan during the execution phase to ensure that all measures are implemented effectively. During the inspection phase, the flatness of the suspended ceiling is tested using measuring tools and compared with the quality standards. If any deviation is found, analyze the reasons during the processing stage, take measures such as adjusting the installation of the keel and correcting the surface of the base layer to correct it, and then enter the next PDCA cycle to continuously improve the flatness of the ceiling. For the adjustment of wall verticality, the PDCA cycle is also followed, from planning to execution, inspection, and handling, constantly dynamically correcting to ensure that the wall verticality meets the requirements.

4.2. Quality monitoring of key construction nodes

4.2.1. Acceptance management of concealed works

Quality management of concealed works is crucial in architectural decoration and renovation projects. Taking the light steel keel partition system and suspended ceiling base as examples, an image traceability system and technical review process should be established [7]. During the construction process, use imaging equipment to capture and record key nodes and concealed areas to ensure traceability of the construction process. At the same time, strictly follow the technical review process, carefully inspect the installation position, spacing, fixing method of light steel keel, as well as the keel structure and connection parts of the ceiling base to ensure compliance with design and specification requirements. Through these measures, the management of concealed engineering acceptance will be strengthened, improve the overall quality of the project, and provide strong support for the smooth progress and

quality assurance of building decoration and renovation projects.

4.2.2. Functional testing management

Special tests such as bathroom water sealing test and curtain wall water spraying test are crucial in the technical management of building decoration and renovation. For the closed water test of the bathroom, technical parameters such as water level height and closed water time should be accurately controlled to ensure that the waterproof effect meets the requirements [8]. The curtain wall water spraying test needs to reasonably determine the spraying area, spraying intensity, and duration, and comprehensively test the waterproof performance of the curtain wall. By improving the technical parameter control standards for these specialized inspections, it is possible to effectively monitor the quality of key construction nodes, ensure the functionality of building decoration and renovation projects, and enhance the quality of the entire building construction project.

5. Innovative application of information management technology

5.1. Construction of project management informatization platform

5.1.1. Architecture of smart construction site management system

In the architecture of the smart construction site management system, constructing a comprehensive digital management module that seamlessly integrates progress management, quality inspection, and material tracking is pivotal for fostering transparency, accountability, and efficiency throughout the entire project lifecycle [9]. The progress management submodule continuously monitors real-time construction milestones by comparing planned versus actual schedules through advanced 4D BIM dashboards, instantly detecting deviations or delays and issuing color-coded alerts. When thresholds are breached, the system recommends data-driven corrective actions such as reallocating labor, adjusting shift patterns, or revising task sequences. The quality inspection submodule empowers field engineers with rugged tablets and IoT-enabled sensors to capture high-resolution images, voice notes, and geo-tagged inspection records, then automatically uploads them to a cloud repository where machine-learning algorithms classify defects, assign severity scores, and create digital punch lists. Each issue is tracked with unique QR codes until closure, ensuring traceability and compliance with ISO standards. The material tracking submodule leverages RFID tags, GPS beacons, and blockchain ledgers to log procurement orders, delivery timestamps, warehouse movements, and on-site consumption, generating tamper-proof audit trails. Predictive analytics anticipate shortages, optimize just-in-time deliveries, and minimize surplus inventory, thereby reducing waste, preventing counterfeit products, and accelerating root-cause analysis when quality anomalies occur.

5.1.2. Development of mobile terminal application scenarios

With the rapid development of information technology, the expansion of mobile terminal application scenarios has become crucial in the management of building decoration and renovation technology. For example, developing a quality inspection and evaluation system based on QR code technology leverages the uniqueness and convenience of QR codes, enabling construction and management personnel to instantly scan and retrieve relevant quality information, specifications, and inspection checklists, thereby achieving high efficiency and precision in quality inspection and evaluation [10]. Simultaneously, the real-time recording function of construction logs on mobile devices is indispensable. Field personnel can utilize smartphones or rugged tablets to capture multimedia evidence—including geotagged photos, voice memos, and annotated sketches—while promptly logging construction progress, emerging problems, and corrective solutions on site. These encrypted logs are automatically synchronized to a cloud dashboard where managers can view them at any time through role-based access, facilitating immediate awareness of project dynamics, data-driven decision-making, and proactive risk mitigation.

Consequently, this seamless integration of mobile technology significantly enhances transparency, accountability, and collaboration, effectively improving the overall efficiency and quality of building decoration and renovation technology management in construction projects.

5.2. Integrated application of Internet of Things technology

5.2.1. Application of environmental monitoring system

The application of integrated environmental monitoring systems is crucial in building decoration and renovation projects. By strategically deploying high-precision temperature and humidity sensors across both open and enclosed work zones, real-time monitoring of the coating construction micro-environment can be achieved. These wireless, battery-optimized sensors accurately sense minute-by-minute fluctuations in temperature and relative humidity and transmit encrypted data streams in real-time through LoRaWAN or 4G gateways to a centralized cloud-based management platform. When any environmental parameter drifts beyond the scientifically validated envelope suitable for primer, putty, or top-coat application, the system instantly triggers multichannel alerts, push notifications to mobile devices, flashing beacons, and audible alarms, ensuring that no critical deviation goes unnoticed. This immediate feedback loop enables construction personnel to adjust ventilation rates, heating, dehumidification, or curing schedules without costly rework, thereby preventing paint quality defects caused by environmental stressors such as excessively rapid or sluggish drying, premature film formation, peeling, cracking, or color variation. Simultaneously, the system continuously logs, timestamps, and geotags every environmental reading, creating a comprehensive historical dataset that can be mined through machine-learning algorithms. These analytics reveal seasonal patterns, zone-specific risk profiles, and optimal application windows, providing an evidence-based reference for the construction environment control of similar projects in the future. Ultimately, this proactive, data-driven approach effectively improves the quality, predictability, and efficiency of building decoration and renovation projects while reducing material waste and enhancing occupant satisfaction.

5.2.2. Application of intelligent construction equipment

In the management of architectural decoration technology, the deep integration and agile application of Internet of Things technology and intelligent construction equipment bring unprecedented conveniences and strategic advantages to the entire project lifecycle. Through pervasive IoT technology, real-time monitoring, granular data collection, and predictive analytics of construction equipment status, material inventory levels, ambient conditions, and workforce movements can be achieved with millisecond-level granularity. For example, multi-parameter sensors can continuously monitor temperature, relative humidity, airborne particulate concentration, volatile organic compounds, and illumination intensity across every zone of the construction environment. The high-frequency data streams are encrypted and relayed to a cloud-based digital twin platform, providing accurate, audit-ready data support for critical decoration decisions and ensuring that coating adhesion, curing profiles, and finish quality consistently exceed specifications. The application of intelligent construction equipment such as automated spraying robots, adaptive troweling arms, and AI-guided, laser-tracked cutting systems not only elevates construction speed by up to 45 percent, but also enhances dimensional accuracy to sub-millimetre tolerances. These devices execute pre-validated, code-compliant programs, dynamically self-correcting for thermal drift or substrate variation, thereby dramatically reducing defects traditionally caused by human fatigue or subjective judgment. Simultaneously, an overarching information management system aggregates heterogeneous data sources—BIM, ERP, IoT telemetry, and mobile field reports—into a unified dashboard. Advanced analytics engines then optimize resource allocation, schedule sequencing, and just-in-time logistics, further elevating the management level, sustainability metrics, and overall quality of building decoration and renovation projects while shortening payback periods for capital investments.

5.3. VR/AR technology assisted management

5.3.1. Virtual construction simulation system

In building decoration and renovation projects, VR technology in virtual construction simulation systems can be used for visualizing construction instructions at complex nodes. By creating an immersive, high-resolution virtual construction environment, intricate node geometries, concealed joints, and multi-layer assemblies are presented in true-to-scale 3-D visualization. Construction personnel wearing lightweight headsets can intuitively inspect every bolt pocket, sealant groove, and tolerance gap, grasping the exact construction sequence, phased connection methods, and interdependencies among structural, MEP, and finish components. This visual disclosure method eliminates the ambiguity and spatial misunderstanding often inherent in traditional two-dimensional drawing disclosure, dramatically improving the mastery of critical construction key points by foremen, trades, and quality inspectors, and thereby ensuring first-time-right construction quality. Simultaneously, VR technology can host parametric simulations of the same node under different construction schemes, altering curing temperatures, fastener types, or staging sequences, allowing multidisciplinary teams to evaluate constructability, clash potential, and ergonomic risks long before mobilization. Early detection of impractical details drives rapid iteration, optimizes the construction process, minimizes costly errors and rework during the actual construction phase, and ultimately elevates overall project productivity and client satisfaction.

5.3.2. Quality verification of augmented reality

Developing an AR comparison system to achieve real-time calibration between decorative finishes and BIM models is an important application for augmented reality quality verification. Through this system, AR technology is used to overlay and compare BIM models with actual decorative finishes. At the construction site, workers can use mobile devices such as tablets or smart glasses to visually observe the differences between the design data in the BIM model and the actual construction situation. This real-time calibration function helps to detect quality issues in a timely manner, such as installation position deviations and size discrepancies of decorative materials. It not only improves the efficiency of quality verification, reduces the possible omissions in manual inspection but also provides accurate basis for subsequent rectification work, ensuring that the quality of building decoration and renovation projects meets design requirements.

6. Conclusion

The management of architectural decoration technology plays a crucial role in building construction projects. Through effective technical management, the construction process can be standardized to ensure that construction personnel strictly follow standard operations, thereby improving the quality of decoration projects. The deep integration of intelligent management technology is an important direction for future development, which will improve management efficiency and achieve real-time monitoring and precise control of project progress, quality, and other aspects. Meanwhile, with the continuous development of big data and AI technology, its application prospects in the field of quality prediction are broad. By utilizing big data to analyze massive engineering data and AI technology for intelligent learning and prediction, potential quality issues can be identified in advance, providing a basis for developing reasonable preventive measures and further promoting the development of building decoration and renovation technology management to a higher level.

Disclosure statement

The author declares no conflict of interest.

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