Exploration of Construction Technology and On-site Construction Management Paths in Building Engineering

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Abstract: Against the backdrop of deepening urbanization, the scale of building engineering construction continues to expand, with building structures becoming more complex, imposing stringent requirements on project quality and construction safety. The advancement and applicability of construction technology directly impact the quality and benefits of engineering projects, while on-site construction management plays a crucial role in controlling construction costs and improving construction efficiency. This paper analyzes the importance of on-site construction management in building engineering, proposes common construction technologies and on-site management paths—such as establishing a refined construction management system, optimizing resource allocation and dynamic scheduling, strengthening whole-process quality control, enhancing the safety risk prevention and control system, and promoting green construction—to facilitate the standardized and modernized development of the construction industry.

1. Introduction

The construction industry holds a significant position in national economic development. The rise of building engineering projects drives social progress and development. As the scale of building engineering projects continuously expands, construction technology and on-site management face new challenges. Advanced construction technology is key to ensuring construction quality and reducing project costs. On-site construction management is a necessary condition for the implementation of construction technology, involving multiple areas such as construction progress, quality, and safety. Therefore, construction enterprises should deeply explore paths for on-site construction management to provide strong support for the sustainable development of the construction industry.

2. Importance of Strengthening On-site Construction Management in Building Engineering

2.1 Ensuring Construction Safety

The on-site environment of building engineering is complex, with potential hazards such as falling objects and electric shocks. By strengthening on-site construction management, construction enterprises can utilize sound safety systems and regular safety training to make construction personnel recognize the importance of safety, understand methods for handling construction risks and emergency response techniques, thereby minimizing the probability of construction safety accidents[1]. Simultaneously, strengthening on-site management can also preemptively eliminate potential safety hazards, ensuring safe and orderly construction, allowing the project to proceed smoothly according to plan and achieving high-quality delivery. The level of construction safety also relates to the reputation and economic benefits of construction enterprises. Once a safety accident occurs, it directly damages the good image accumulated by the enterprise over time and weakens its competitive advantage in the market. Therefore, strengthening on-site management is a necessary measure to ensure construction safety.

2.2 Improving Project Construction Quality

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Strengthening on-site construction management in building engineering can ensure the quality of construction materials and equipment, preventing substandard products from entering the construction site. Standardized construction management measures can also regulate construction processes and operational procedures, ensuring all work is executed within specified standards, improving the strength and density of the building engineering structure. Furthermore, effective on-site management helps construction managers promptly discover and address quality issues, formulate countermeasures in a short time, and eliminate potential quality and safety hazards at the source.

2.3 Controlling Engineering Project Costs

The level of cost control in building engineering projects is closely related to their economic benefits. Strengthening on-site construction management can effectively improve the level of project cost control. On-site construction involves materials, personnel, processes, and other aspects, each generating certain costs. A sound on-site management strategy can reasonably arrange the number of personnel for various trades, enabling everyone to utilize their maximum potential and reducing unnecessary man-hour waste. In material control, it also allows for precise calculation of material usage, avoiding inventory backlog and capital occupation caused by over-procurement, achieving precise control of material costs. Additionally, effective on-site management can standardize construction processes, avoiding rework due to quality issues and reducing various additional costs.

2.4 Enhancing Construction Efficiency

On-site construction management in the building engineering field precisely coordinates various resources and processes, playing a decisive role in improving construction efficiency. Reasonable on-site management can optimize resource allocation. Construction enterprises can dynamically deploy personnel based on construction progress and needs, enabling different trades to work efficiently at the right time and position. Effective management can also formulate detailed and reasonable construction plans, clarifying tasks, timelines, and responsible persons for each stage, ensuring construction proceeds according to plan. Furthermore, strong on-site management, through strict enforcement of quality standards, promotion of standardized operations, and implementation of continuous safety inspections and education, can fundamentally prevent most problems and accidents, ensuring construction activities proceed continuously and smoothly, thereby fundamentally improving overall construction efficiency.

3. Analysis of Construction Technology in Building Engineering

3.1 Concrete Construction Technology

Concrete construction technology is a core technical means in the building engineering field, its quality relates to the durability and safety of the building structure. The main link in its specific operation is concrete mixing. Forced mixing equipment is selected, and the feeding order and mixing time are controlled. Generally, sand, aggregate, cement, and admixtures are first added for uniform dry mixing. The mixing time should be no less than the specified value to avoid problems such as segregation or bleeding. The curing link of concrete construction technology is crucial. Within 12 hours after pouring, moisture-retaining curing measures should be taken, such as covering. The curing time for ordinary concrete should be more than 7 days. Curing agents can be sprayed or plastic film can be used to cover the surface to keep the concrete structure moist.

3.2 Soft Soil Foundation Treatment Technology

Soft soil foundation treatment is an important link to ensure building safety and structural stability. Soft soil has characteristics such as high water content and compressibility. Direct construction can cause problems like building tilting or settlement. In the application of soft soil foundation treatment technology, the replacement method is a common technique. It mainly involves removing the weak soil layer at the foundation base and replacing it with materials of

higher strength and lower compressibility, effectively improving the foundation's bearing capacity. For deep soft soil foundations, the dynamic compaction method can be chosen, using the impact force from the free fall of a heavy hammer to compact the foundation soil, allowing soil particles to rearrange and increase overall density.

3.3 Steel Structure Construction Technology

Steel structure construction technology is a core supporting technology in modern building engineering, with advantages such as short construction cycles and lightweightness. It is widely used in projects like high-rise buildings and bridges. Steel structure construction technology is primarily based on material and component processing. Component processing usually employs techniques such as CNC cutting and automatic welding[2]. Simultaneously, on-site installation is also very important. Large steel structures generally adopt the block lifting method, using facilities like tower cranes or crawler cranes to ensure the precise placement of prefabricated components. Additionally, steel structure construction technology also involves anti-corrosion treatment measures, choosing sandblasting for rust removal combined with coatings to form a composite protective layer, enabling the building's steel structure to be used for a long time in harsh environments.

4. Effective Paths for On-site Construction Management in Building Engineering

4.1 Establishing a Refined Construction Management System

On-site construction management in building engineering should establish a refined construction management system. A standardized process framework should be built, dividing the entire construction cycle of the building engineering project into several nodes, clarifying the technical standards and the responsible entities for quality acceptance at each construction stage. Visual disclosure templates should be used to achieve traceability of construction operations. Construction enterprises should also strengthen a dynamic data-driven decision-making mechanism. With the support of BIM technology, construction and operation data should be integrated. Construction enterprises should use IoT sensors to collect on-site environmental parameters and equipment operating status in real-time. Supported by big data analysis platforms, a dynamic risk early warning model should be established to truly achieve accurate prediction and dynamic adjustment of process interfaces. On this basis, on-site construction management should actively promote a grid-based management model, subdividing the construction site into different management units, matching dedicated grid personnel responsible for safety inspections and progress tracking. An associated mechanism combining problem discovery and rectification analysis should be established. Mobile terminals should be used to report construction safety hazards and feedback results, ensuring management commands can be implemented. Furthermore, construction enterprises should build a full-element collaborative supply chain management system, establishing strategic cooperative relationships with material suppliers and equipment lessors to ensure project construction quality from the source. Construction enterprises should prioritize talent echelon development, conducting training activities themed on smart construction sites and lean construction, guiding construction personnel to familiarize themselves with new thinking and technologies, promoting the transformation of on-site management towards intelligence-driven direction, and providing systematic solutions for high-quality engineering construction.

4.2 Optimizing Resource Allocation and Dynamic Scheduling

On-site construction management in building engineering should optimize resource allocation and dynamic scheduling. A digital resource management platform based on BIM technology should be constructed to integrate elements such as manpower, materials, and machinery. The resource demands and distribution status of various construction areas should be presented visually through 3D models, providing reliable data support for precise resource configuration in building construction. In the resource allocation link, on-site management should adhere to the principle of

combining dynamic reserves and gradient deployment. Resource demand curves should be compiled according to the construction schedule. A just-in-time supply mode should be adopted for materials on the critical path. For non-critical paths, construction enterprises should establish regionalized resource pools, improving equipment utilization through shared leasing models. Additionally, in the dynamic scheduling link, construction enterprises should establish a three-level response mechanism. First-level scheduling requires the project manager to adjust the daily work surface based on factors like climate and process interfaces. Second-level scheduling requires the engineering department to use terminal devices to monitor the actual progress of various construction teams, truly achieving flexible complementarity of human resources[3]. Third-level scheduling should use IoT sensors to deeply analyze large equipment like concrete mixers and tower cranes. Furthermore, on-site construction management should build a resource scheduling performance dashboard, linking material and equipment utilization rates with construction team assessments, using positive incentives to encourage all staff participation in resource optimization, ensuring resource allocation remains highly adaptable to construction dynamics.

4.3 Strengthening Whole-Process Quality Control

On-site construction management in building engineering should emphasize whole-process quality control. In the construction preparation stage, construction enterprises must strictly review construction drawings and technical plans, organize joint briefings for various professions to ensure smooth interface between construction processes and design intent. Construction enterprises should also establish a material and equipment access mechanism, implementing a three-party joint inspection system for materials entering the site, and leveraging the advantages of QR code traceability systems to achieve transparent management of quality information. During construction, a three-level quality control network should be established. Construction teams should focus on inspecting the standardization of construction process operations, providing standardized operational guidance for links like concrete pouring and rebar tying on site. The project department should use BIM technology to precisely control the verticality and flatness of the building structure. Construction supervision units should focus on the acceptance of concealed works. When dealing with common quality issues in building construction, construction enterprises should establish a smart site platform to collect construction environment data in real-time, issue warnings when detected data deviates from standards, and then jointly adjust construction parameters and suspend operations. Additionally, in the quality acceptance link, on-site management should strictly implement a joint acceptance system, establish a quality traceability and optimization mechanism, continuously optimize construction processes using the PDCA cycle, and ultimately form full-process quality control.

4.4 Establishing a Safety Risk Prevention and Control System

On-site construction management in building engineering should prioritize safety prevention and control, establishing a safety risk prevention and control system. The principles of prevention first and hierarchical prevention and control should always be adhered to. From the perspective of the project's entire lifecycle, risks should be systematically identified during the construction preparation stage using methods like BIM technology and expert demonstration. Risk lists should be established for high-risk projects like deep foundations and high formwork, determining the risk level and management responsible person for each process. Simultaneously, construction enterprises should establish a dual prevention mechanism, deeply integrating risk graded management and control and hidden danger investigation. Utilizing regular methods like safety briefings and weekly special inspections, risk sources should be monitored in real-time, and closed-loop management strategies should be adopted. On this basis, construction enterprises should establish a multi-party collaborative construction safety supervision network, partnering with engineering supervision and third-party safety consulting agencies to establish a scientific and reasonable linkage mechanism. Upon discovering safety hazards, the responsible person should be identified immediately, providing a solid safety guarantee for the safe construction of the building engineering project.

4.5 Actively Promoting Green Construction

On-site construction management in building engineering should actively promote green construction. Construction managers should adopt systematic, whole-process environmentally friendly management methods. During the construction preparation stage, detailed special green construction plans should be formulated, clarifying specific goals and control measures for energy saving, material saving, and environmental protection, and integrating them into the project management outline to ensure green concepts are embedded in engineering practice from the source[4]. Construction enterprises should vigorously promote technologies for efficient resource utilization, adopting energy-saving machinery and equipment, implementing rainwater recycling systems, reducing transportation carbon emissions, and using BIM technology for precise material calculation and prefabrication processing to minimize on-site waste. The entire construction process must attach great importance to environmental protection, focusing on ecological conservation and humanistic care. Construction layout should be reasonably planned to reduce land disturbance. The on-site environment can be improved by setting up green enclosures and creating temporary green belts. Furthermore, on-site construction management should implement construction waste classification management, setting up dedicated recycling pools for metals, wood, concrete, etc., and establishing a closed-loop system for construction waste treatment in conjunction with professional recycling enterprises—for example, using crushed waste concrete for road base paving and increasing the reuse rate of wooden formwork. In the green construction link, a digital management platform can be built to monitor energy consumption, environmental parameters, and other data in real-time, ensuring green construction transforms from a concept into a promotable standardized practice.

5. Conclusion

In summary, construction technology and on-site construction management in the building engineering field jointly promote the stable development of the construction industry. Effective on-site management can translate advanced construction technology into practical results. Therefore, construction enterprises should establish a refined construction management system, optimize resource allocation and dynamic scheduling, strengthen whole-process quality control, establish a scientific and reasonable safety risk prevention and control system, and actively promote green construction to provide strong support for the high-quality development of the construction industry.

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