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Research on the Whole-process Construction Management and Control System of Prefabricated Buildings Based on BIM Technology

Yujun Liu*

Hainan Vocational University of Science and Technology, Haikou 570000, Hainan, China

Author to whom correspondence should be addressed.

Abstract: Prefabricated buildings serve as the core carrier of industrialized and green construction. Nevertheless, they feature long construction chains, multiple participating entities, and high precision requirements. Traditional management and control modes are plagued by pain points such as low collaborative efficiency, high rework rate, and poor traceability, which can hardly meet the demands of refined construction. With technical characteristics including parameterization, visualization, collaboration, and full-life-cycle data connectivity, BIM technology provides core technical support for upgrading the construction management and control of prefabricated buildings. In view of this, this paper conducts in-depth research on the whole-process construction management and control system of prefabricated buildings based on BIM technology, so as to offer references for the high-quality construction of prefabricated buildings.

Keywords: BIM technology; Prefabricated buildings; Construction management and control; Whole-process construction management and control system

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1. Introduction

Alongside the industrial, green and digital transformation of China's construction industry, prefabricated buildings have become the primary approach to boost the high-quality development of the construction industry due to their advantages of high construction efficiency, low resource consumption and minor environmental impact [1]. The Development Plan for the Construction Industry During the 14th Five-Year Period proposes to vigorously develop prefabricated buildings and raise their proportion in new buildings to more than 30% by 2025. Prefabricated buildings transfer a large number of on-site operations to factory prefabrication. Their construction links cover design, production, transportation, hoisting and acceptance, involving multiple stakeholders including developers, design institutes, component factories, construction units and supervision companies, which raise higher requirements for refined, information-based and collaborative construction management and control [2].

Under traditional management and control modes, prefabricated buildings commonly suffer separation between design and production, inconsistent component information, disorderly hoisting procedures, frequent collision rework and difficult quality tracking, resulting in delayed construction schedules, cost overruns and severe hidden quality hazards, which hinder the popularization of prefabricated buildings. BIM technology integrates geometric, physical, functional and management information of the whole building life cycle by relying on 3D digital models. It boasts core strengths such as parametric modeling, visual simulation, collaborative management and traceable data, which are highly consistent with the inherent demands of prefabricated buildings for standardized design, factory production, assembly construction and information management [3].

In recent years, numerous domestic projects have explored the application of BIM technology in prefabricated buildings. However, most applications merely stay at the stage of visual demonstration for single links, without forming a systematic management and control system covering all construction procedures, and the value enabled by technology has not been fully unleashed. Therefore, starting from the adaptability between BIM technology and prefabricated building construction, this paper tests the application effect through engineering demonstration and constructs a whole-process construction management and control system, so as to provide practical references for improving the construction control level of prefabricated buildings.

2. Adaptive characteristics of BIM technology in prefabricated building construction

2.1. Parametric component attributes adapt to refined management demands

The core units of prefabricated buildings are standardized prefabricated components. A single project involves thousands of prefabricated wall panels, composite slabs, staircases, and other components, each with strict technical requirements on dimensions, steel reinforcement, and embedded parts as well as installation joints. Traditional 2D drawings cannot realize granular management [4]. BIM technology assigns a unique identity code to each prefabricated component through parametric modeling, integrating all information, including geometric dimensions, material parameters, production requirements, hoisting joints, and quality standards, to realize unified management via one model. Managers can quickly retrieve component information and accurately grasp technical requirements of each component through the model, fundamentally eliminating production errors and installation deviations caused by information mistakes, and satisfying the refined management demands for prefabricated buildings featuring massive and diversified components [5].

2.2. Visual simulation adapts to high-risk hoisting operations

On-site construction of prefabricated buildings mainly relies on component hoisting. The hoisting procedures of heavy prefabricated components are complicated, with high spatial precision requirements. Traditional construction depends on technicians' experience, which easily leads to chaotic hoisting sequences, spatial collisions, and large positioning errors, bringing significant safety and quality risks [6]. BIM technology can create 3D visual construction scenarios to conduct pre-simulation of hoisting procedures, mechanical paths, and component positioning processes, predict risks such as spatial conflicts and blind areas in advance, and optimize hoisting sequences and mechanical positions. Construction workers can clearly identify hoisting points, sequences, and installation requirements via 3D models instead of traditional 2D drawing disclosure, reducing hoisting errors caused by inconsistent understanding and improving the accuracy and safety of hoisting operations.

2.3. Multi-terminal collaborative platform solves cross-stakeholder collaboration pain points

The construction chain of prefabricated buildings is lengthy with numerous participating units, and links including design, production, transportation, and construction are distributed in separate spaces. Traditional communication dominated by paper drawings and offline meetings delivers information with low efficiency and a high error rate, easily triggering collaborative problems such as delayed transmission of design changes and mismatches between production and on-site progress [7]. The cloud collaborative platform built based on BIM technology enables cloud sharing of models and data, allowing all participants to conduct collaborative work based on one unified model. Design institutes update design changes online, component factories receive the latest production demands in a timely manner, construction units upload on-site progress synchronously, and supervision companies conduct online quality acceptance, breaking information barriers between all stakeholders and realizing efficient cross-regional and cross-link collaboration, which significantly cuts management losses caused by information asymmetry.

2.4. Full-life-cycle data connectivity meets quality traceability requirements

Quality control of prefabricated buildings emphasizes traceability. Production records, transportation status, installation precision, and acceptance records of all components need to be retained. Traditional paper file management leads to scattered data and inconvenient retrieval, making it hard to quickly identify responsible links once quality problems occur [8]. BIM models can carry full-process data covering design, production, construction, and acceptance. Production records, transportation information, hoisting data, and acceptance materials of each component are bound to component codes in the model, forming a complete quality information chain. In case of quality defects, staff can rapidly retrieve full-process information through component codes to locate the source and responsible parties. The complete data chain also provides data support for later operation and maintenance phases.

3. Whole-process application of BIM technology in prefabricated building construction management and control

3.1. Deepening design stage: Forward design and collision inspection to control risks from the source

Deepening design serves as the first step of prefabricated building construction, and its accuracy affects the quality of subsequent production and installation [9]. Based on BIM technology, forward deepening design of prefabricated buildings can be carried out. Relying on architectural, structural, and electromechanical professional models, standardized splitting of prefabricated components is conducted, and component splitting schemes as well as joint connection designs are optimized to guarantee production feasibility and installation convenience. Meanwhile, a BIM collision detection function is adopted to conduct full-professional collision inspection on embedded parts, reserved holes, and electromechanical pipelines of prefabricated components, identify design conflicts in advance, issue collision reports and optimize design schemes, so as to avoid on-site rework resulting from design defects from the source. In addition, each prefabricated component is assigned a unique RFID code during deepening design, which is associated with specifications, material properties, production requirements, and installation positions of components, establishing a one-component-one-code management system to provide data support for full-process traceability [10].

3.2. Production and transportation stage: Linkage of BIM and Internet of Things to realize accurate matching between supply and demand

Component production and transportation act as an intermediate link connecting design and on-site construction, which influences on-site construction progress [11]. The BIM model is connected to the component production management system to directly transmit component design parameters to the production end, reducing errors and workload from secondary drawing. During production, raw material inspection, production procedures, and quality test data of components are timely uploaded to the BIM model, realizing online visual control of production progress and quality. Managers can grasp the production status of each batch of components via the BIM model and adjust production plans according to on-site construction progress to match production with on-site demands. In the transportation link, component transportation batches and loading sequences are optimized based on the hoisting sequence in the BIM model, enabling components to be produced, transported, and hoisted in order, and cutting costs of on-site stacking and secondary handling. Real-time positioning technology of the Internet of Things is utilized to track the location of transport vehicles, and transportation progress is synchronized to the BIM collaborative platform, allowing on-site managers to make hoisting preparations in advance and improve construction connection efficiency [12].

3.3. On-site hoisting stage: Visual management to ensure schedule, quality and safety

On-site construction constitutes a critical link for control. Relying on BIM models, the project built a centralized on-site construction management and control platform to conduct all-round and refined control over schedule, quality and safety [13]. In terms of schedule control, the BIM model is linked to detailed construction schedules to generate a 4D construction schedule simulation, which can clearly and dynamically reflect construction tasks, process connections and component demands at each stage, so as to achieve full control over construction progress. During construction, actual on-site progress data is collected and uploaded to the system daily for automatic comparison and intelligent analysis against planned schedules. Once deviations occur, the system will send out early warning signals immediately, allowing the project team to promptly adjust resource allocation or construction schemes and ensure controllability of key construction milestones. For quality control, an innovative collaborative approach integrating BIM and mobile terminals is adopted. On-site managers can retrieve complete BIM information of components to be installed anytime via handheld mobile devices, accurately verify component models, specifications, and designed installation positions, and timely record key data such as hoisting positioning accuracy and connection quality. All detected quality defects are photographed, marked, and uploaded to the management and control platform right away to generate problem tracking forms, realizing closed-loop whole-process management covering defect identification, assignment, rectification, and re-inspection. For critical processes with complex craftsmanship and stringent quality requirements such as sleeve grouting, 3D visualized technical disclosure based on BIM models is carried out to help workers fully grasp operation procedures, technical specifications, and acceptance criteria, fundamentally eliminating potential quality hazards. In terms of safety control, leveraging the pre-simulation advantage of BIM technology, simulated analysis of hazard sources and key safety protection points within hoisting operation areas is conducted in advance to optimize the layout plan of safety protection facilities. Meanwhile, collision simulation is performed for the operating radii and lifting paths of large hoisting machinery such as tower cranes, which effectively avoids interference risks between machinery units and between machinery and structures, and enhances the predictability and management capacity of on-site safety supervision.

3.4. Completion acceptance stage: Digital delivery to connect operation and maintenance management

During the completion acceptance phase, the project takes complete BIM models as carriers to integrate all data generated throughout construction, including partial and sub-item quality acceptance records, factory and on-site component test reports as well as design change and negotiation records, creating a digital completion model fully consistent with the physical building in geometric and attribute information [14]. This model completely replaces traditional scattered and vulnerable paper completion materials, greatly accelerating the retrieval, comparison, and verification of materials during acceptance, and guaranteeing the integrity, accuracy, and long-term traceability of engineering archives. The value of the completion BIM model does not end at acceptance; it can be directly delivered to the subsequent operation and maintenance phase as core data assets. It provides accurate and intuitive data support for equipment maintenance, space asset management, energy consumption management, and emergency plan formulation and simulation after building commissioning, realizing full-life-cycle data connectivity and value continuation covering design, construction, and operation across the whole construction industrial chain, and expanding the wider and deeper application scope of BIM technology in the construction industry [15].

4. Conclusion

Prefabricated buildings represent an inevitable trend of construction industrial upgrading, and BIM technology serves as the major technical means to raise the management and control level of prefabricated construction. Through analysis of adaptive characteristics and system construction based on engineering verification, this paper summarizes the adaptive advantages of BIM technology in parametric control, visual simulation, collaborative management, and full-life-cycle traceability, and verifies its prominent strengths in schedule, quality, cost, and collaboration. A whole-process construction management and control system covering deepening design to on-site construction and completion delivery is established. In the future, with the in-depth integration of digital twin, Internet of Things, artificial intelligence, and BIM technologies, the construction control of prefabricated buildings will develop toward higher intelligence and precision. The industry shall further deepen the full-life-cycle application of BIM technology, break data barriers across all sectors, promote the digital and intelligent construction of prefabricated buildings, and drive the high-quality development of the construction industry.

Disclosure statement

The author declares no conflict of interest.

References

[1] Song XG, Li ZH, Yao X, 2023, Research on Whole Industrial Chain Quality Management of Prefabricated Buildings Based on BIM. Journal of Engineering Management, 37(5): 30–35.

[2] Ding DS, Lu H, 2023, Research on Application of BIM Technology in Intelligent Construction of Prefabricated Buildings. Construction Economics, 44(S01): 293–296.

[3] Zhu L, Lu SW, Liang JF, et al., 2022, Analysis and Evaluation of Energy Conservation and Emission Reduction of Prefabricated Buildings Based on BIM Technology. Construction Economics, 43(S02): 302–306.

[4] Rong BW, Wang Y, 2023, Research on Whole Life Cycle Analysis and Optimization of Prefabricated Buildings Based on LSS-BIM5D. Construction Economics, 44(S02): 348–353.

[5] Yang LR, 2025, Research on Whole-process Cost Control of Prefabricated Buildings Based on BIM Technology. Earthquake Resistant Engineering and Retrofitting, 47(2): I0017.

[6] Ma H, Zhang HB, Wang YN, 2020, Identification of Parallel Construction Spatial Conflicts of Prefabricated Buildings Based on BIM. Journal of Safety Science and Technology, 16(2): 7.

[7] Zhou XH, Jiang L, Deng C, et al., 2024, Research on Green and Low-carbon Practice of Prefabricated Buildings in Hot Summer and Cold Winter Zones Based on BIM Technology. Building Science, 40(8): 34–41 + 51.

[8] Chen Y, Yang B, Lu XS, 2021, Positioning of Prefabricated Building Components Based on BIM and Laser Scanning Technology. Laser Journal, 2021(10): 42.

[9] Zheng ZG, Hua JJ, Zhang SQ, et al., 2023, Standardized Design of Prefabricated Buildings Based on Whole-process System Integration. Building Structure, 53(S01): 1183–1189.

[10] Tang WB, Tang R, 2021, Design of Intelligent Engineering Management System for Prefabricated Buildings Based on BIM Technology. Modern Electronic Technology, 44(18): 4.

[11] Tao HX, Wang SF, Shi YB, et al., 2022, Engineering Management of Prefabricated Steel Structure Buildings Based on BIM Technology. Building Technology, 2022(3): 53.

[12] Zhao XC, 2025, Practice of Whole-process Information Management Integrated with Prefabricated Buildings and BIM Technology. Proceedings of 2025 Engineering Innovation and Sustainable Development Exchange Conference (Volume I), 2025: 514–515.

[13] Yang NX, 2025, Application of BIM Technology in Quality Management of Prefabricated Building Projects. Engineering Technology Research, 10(23): 145–147.

[14] Li ZY, Xu J, 2026, Research on Information Management of Prefabricated Buildings Based on BIM Technology. Journal of Tianjin University of Technology, preprint, 1–8.

[15] Yi SL, Meng YC, Yang YC, 2025, Research on Refined Construction Management Application of Prefabricated Buildings Based on BIM Technology. Theoretical Research in Urban Construction (Electronic Version), 2025(33): 32–34.