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Innovative Application and Practice of Glodon BIM Technology in the Construction Phase of Building Projects: A Case Study of the Zhongye Shuhua Mingyuan Community in Wuhan

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Abstract: *Glodon BIM (Building Information Modeling) technology significantly enhances the reliability and precision of building solutions by deeply integrating digital means, building project information, visual simulations, and construction processes, combined with the application of 3D cloud technology. Taking the Zhongye Shuhua Mingyuan Community project in Wuhan as an example, this paper systematically explores the innovative application models and practical pathways of Glodon BIM technology during the construction phase. The project implemented Glodon BIMMAKE software to establish a 3D visual construction management system. Applications included structural modeling, site optimization, scaffolding detailing, and process visualization. This approach overcame limitations of traditional 2D drawing-based methods, significantly advancing construction digitization and project management informatization.*

Keywords: *Building Information Modeling (BIM); Glodon BIMMAKE; Main Structure Model Creation; Site Model Optimization; Detailed Design of Formwork Support*

1. Introduction

With the advancement of new infrastructure construction, traditional 3D modeling techniques, while capable of constructing building models, suffer from low efficiency, high time consumption, and significant limitations in their application. These shortcomings have made it increasingly difficult to meet the evolving demands of the modern construction industry. In contrast, Building Information Modeling (BIM) technology, leveraging its digital and integrated capabilities, offers transformative potential for the sector and holds significant value in quality control[1]. As an emerging information technology in construction, BIM has become a key trend and represents a new direction for developing high-quality productive forces. Covering the entire project lifecycle—from initial design and construction to operation and eventual demolition—BIM facilitates coordination across all stages and enables concurrent construction processes. This integrated approach provides substantial advantages for project delivery[2].

Against this context, this paper takes the Zhongye Shuhua Mingyuan Community project in Wuhan as a case study. By employing Glodon BIM design tools and BIMMAKE civil engineering detailing software, the project optimizes the design during the construction phase and actively explore the practical application of integrated design and construction.By deeply investigating the innovative application and practice of BIM technology in the construction phase, it can enhance construction productivity and efficiency, improve constructability, save time and costs, and ultimately advance more sustainable construction processes[3].

2. Project Overview and Design Software

2.1 Project Overview

The project is located in Qingshan District, Wuhan City, Hubei Province, and involves the construction of a new residential complex with extensive green areas. The total construction area is

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45,580.83 m², consisting of 34,020.00 m² above ground and 10,837.77 m² below ground. The designed service life of the structure is 50 years, and the structural safety classification is Grade II. The seismic fortification intensity is set at 6 degrees, corresponding to Seismic Design Group 1, with a structural damping ratio of 0.05 and a seismic grade of Level IV. The development includes three high-rise residential buildings (Towers 1–3#), which feature cast-in-place reinforced concrete shear wall structures, with certain horizontal components employing precast concrete elements. Ancillary public buildings are designed using cast-in-place reinforced concrete frame structures.

2.2 Selection of Design Tools and Design Steps

To promote the adoption of domestic BIM modeling software, this project utilizes BIMMAKE Civil Engineering Detailing Software and BIMMAKE Site Planning Software, developed by China's Glodon Technology Co., Ltd., based on proprietary intellectual property in graphics and parametric modeling technologies. These tools are engineered for BIM engineers and technical specialists to support full-construction-process BIM modeling and specialized applications.

The software natively supports design formats from digital dimension tools, enabling multi-purpose model application and systematic detailed civil engineering design. By delivering precise engineering quantities and model information, it enhances project profit margins while fulfilling applications such as detailed design drafting, construction quantity calculation, and visual technical disclosure guidance [4]. The specific design workflow for this project is illustrated in Figure 1.

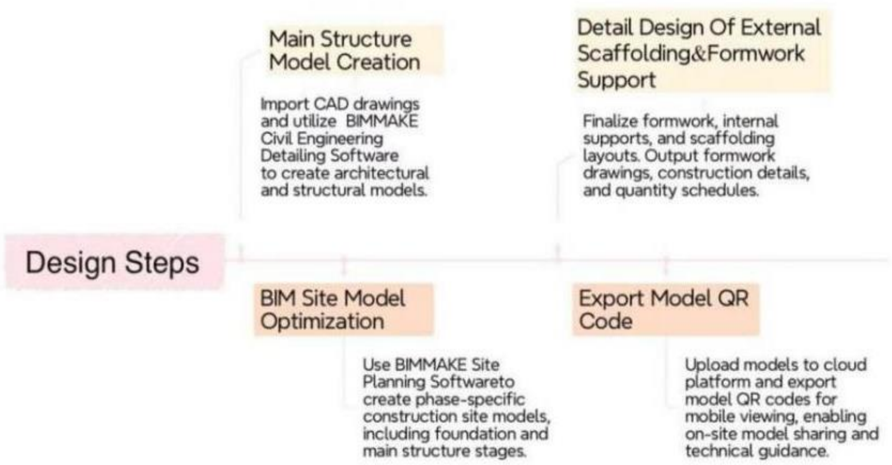

Figure 1 Design process flowchart

3. Application of BIM Technology in the Construction Phase

Glodon's software utilizes BIM to integrate various processes and phases through enhanced collaboration and the adoption of interoperable formats[5]. The BIM model modeling tool is primarily used for creating construction models and visualizing construction sites, with the final models uploaded to the cloud for intuitive display. The workflow includes main model creation, site model optimization, scaffolding and formwork support detailing, and visual construction process demonstration.

3.1 Application of BIM Technology in Main Structure Model Creation

This project involves a typical residential building, featuring well-defined functional zoning, a relatively simple structural system, and stable construction sequencing. The primary objective of model development is the reuse of unit layouts, representing a distinct contrast to the modeling approaches required for other building typologies.

Therefore, during the main modeling phase, upon entering the base modeling environment, the workflow begins by identifying existing gridlines or manually drafting the axis system, followed by setting coordinates and elevation benchmarks, ultimately proceeding to construct wall systems and the

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terrain model, ensuring precise component positioning throughout the sequential workflow. Model accuracy requirements mandate precise component positioning, with particular emphasis on the accurate geometric representation of individual elements; the modeling methodology follows scientifically organized construction sequencing principles through layered and phased modeling techniques. By importing CAD floor plans into BIMMAKE civil detailing software, architectural and structural models are developed while concurrently establishing a basic terrain model, as illustrated in Figure 2.

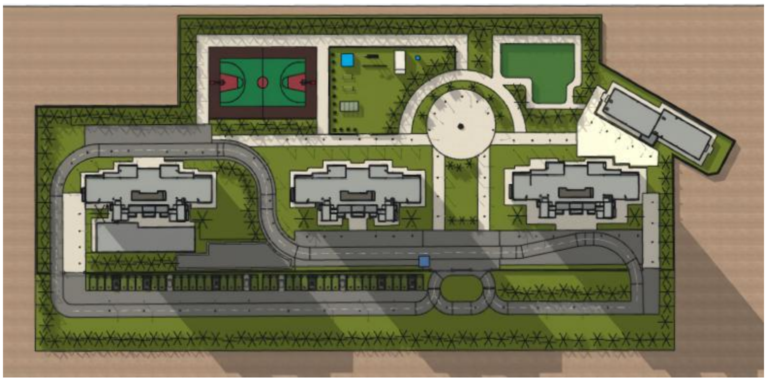

Figure 2 Main structure model plan view

Following model development, construction guidance is delivered through preliminary detailed design based on the model. Utilizing BIMMAKE Civil Detailing Software, formwork detailing is performed across all critical phases: fabrication, installation, concrete pouring, and stripping. This process concurrently generates detailed formwork layout diagrams and assembly drawings. At this stage, the preliminary design is mostly complete. The BIMMAKE Civil Detailing Software work starts with the construction drawings phase, after creating all the main structural and terrain models. Using these models, we then build secondary structural elements to construction drawing standards. This completes the main model's basic building components - including walls, columns, floors, openings, doors, windows, stairs, and ramps - as shown in Figure 3.

Figure 3 Main Model

Completed models were uploaded to the cloud, generating QR codes or links for lightweight 3D model viewing on mobile or other devices. This enabled project teams to quickly access models on-site or remotely, improving communication efficiency. For example, supervisors could compare models with on-site conditions via mobile apps, flagging issues for resolution.

3.2 Optimization Analysis of Site Models Using BIM Technology

3.2.1 Construction Schedule Simulation

BIM technology application during the construction phase manifests in construction simulation and schedule management. Following completion of the primary structural model, BIM technology enables construction simulation and schedule management. Specifically, after completing the primary structural model, detailed simulations are executed to scientifically divide construction zones, develop precise schedules, and optimize resource allocation. Critically, by simulating the building process before physical construction begins – including visual walkthroughs, risk analysis, and timeline planning – project teams

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can proactively identify workflow conflicts and prevent productivity losses, as documented in reference [6].

For schedule management, BIM technology enables construction teams to monitor site progress in real-time (Figure 4). By integrating with project Gantt charts, it facilitates project planning, coordination, and progress tracking. Furthermore, when combined with sensors and IoT devices, BIM's automated monitoring and alert systems enhance management efficiency through real-time progress surveillance.

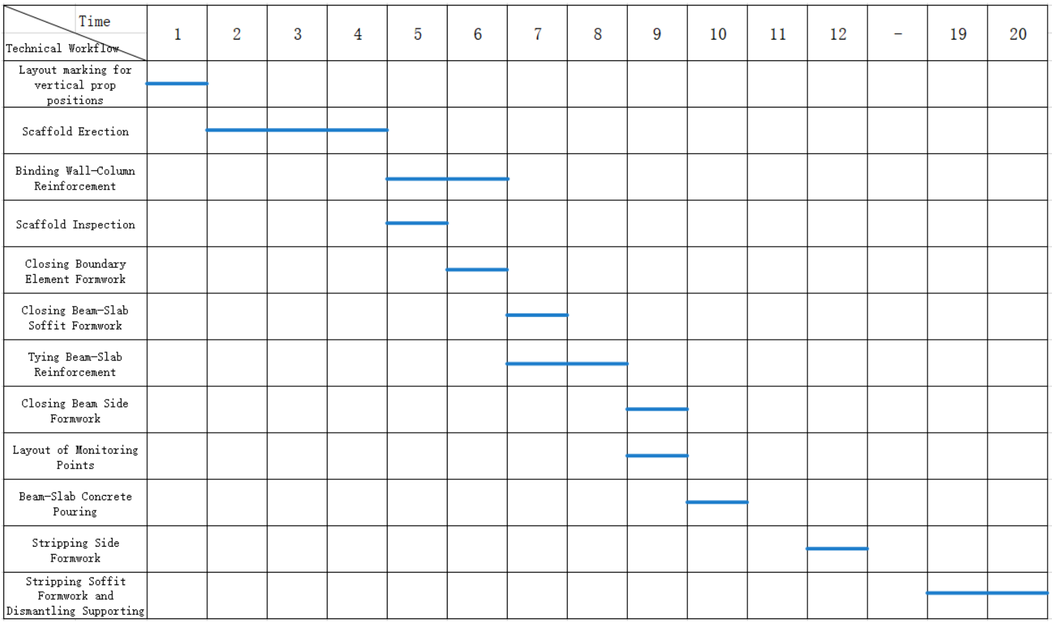

Figure 4 Construction schedule Gantt chart

3.2.2 Optimization of Construction Site Layout

Construction site layout simulation replaces conventional 2D drawings with an intuitive three-dimensional model, integrated with a 3D environment, to more precisely anticipate and optimize the entire construction preparation process[7]. BIM technology generates comprehensive 3D models that visually represent construction site layouts, temporary facilities placement, and access route planning. This visualization capability allows project stakeholders to effectively assess site arrangement efficacy, thereby resolving inherent limitations of 2D CAD drawings in conveying spatial relationships and three-dimensional representation. Compared to traditional construction site management practices, the research and engineering significance of BIM-based site layout planning in building engineering projects has progressively emerged [8].

Prior to site optimization, first determine the building location and tower crane positioning. The crane boom should maximize coverage of the entire construction area to minimize blind zones, eliminate material double-handling, and ensure load-bearing capacity and stability at attachment points. The tower crane attachment details for this project are shown in Figure 5.

Figure 5 Crane attachment diagram

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Based on analysis of the surrounding transportation infrastructure, this project determined the optimal gate location by considering the maximum length, width, and turning radius of typical construction vehicles. The gate is oriented to allow vehicles to enter the site roads smoothly. Upon entry, vehicles pass through an automated washing station.

The construction site necessitates precise delineation of various functional zones, with clearly demarcated separations between each zone and the provision of corresponding facilities. Initially, the positioning of functional zones should be determined based on the architectural layout within the construction site and the coverage range of tower cranes, thereby establishing distinct areas for living quarters, office spaces, and construction operations, ensuring a tripartite segregation of zones.

In the site planning software, select the "Cloud Component Library" function to set the required dimensions and insert temporary facilities such as offices, dormitories, and canteens. Combined with the layout of on-site greening, equipment, facilities, and surrounding environment conditions, this realistically visualizes the construction site layout, as shown in Figures 6.

Figure 6 Living area | and Office area

The placement of material storage areas in construction site layout planning is an essential aspect of construction management. Well-planned material storage areas can enhance construction efficiency, reduce double-handling costs, and ensure site safety and tidiness. To align with the construction schedule, use the "Material Storage Areas" function to place materials (e.g., rebar, formwork, scaffolding) within the storage areas. Also, set up facilities like rebar fabrication sheds and carpentry sheds, and configure their dynamically linked parameters (such as the power load for rebar bending machines). The 3D model shows the storage area layout, helping spot and fix issues early. It also updates material inventory in real-time to ensure efficient material use, as shown in Figure 7.

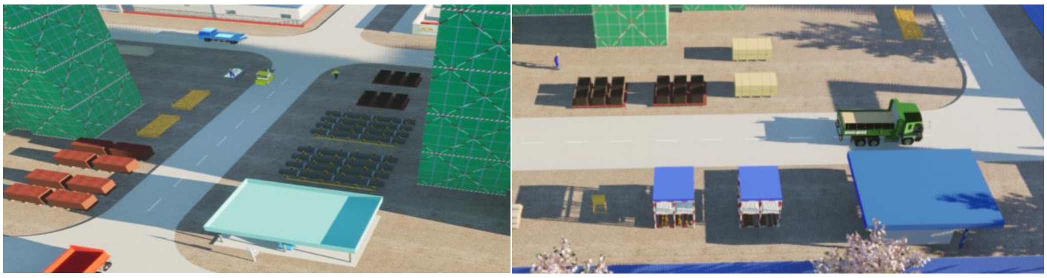

Figure 7 Material storage area

The users put the Quality Sample Display Area and Safety Experience Zone on the right side of the construction area, arranged in a straight line along the access road. Specifying the dimensions for these areas, then using the "Plugins" feature to place the culture wall. Next, users select sample display models from the Cloud Plugin Library for insertion, maintaining neat and aesthetic arrangements to showcase new technologies, materials, and construction methods. Finally, users establish a Safety Briefing Zone on-site for centralized worker safety education, as shown in Figure 8.

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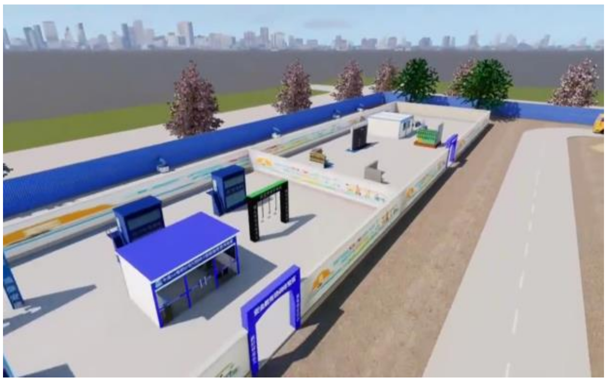

Figure 8 Quality and safety demonstration area

The application of BIM technology in site layout planning facilitates the construction industry's transition from traditional 2D design to 3D digital design and management, driving digital transformation in the sector. This technology reduces change orders and rework during construction, enables pre-construction process simulation for early problem identification and resolution, implements information sharing and collaborative workflows, and enhances precision in project management.

3.3 Detailing Design of Scaffolding and Formwork Supports Using BIM Technology

3.3.1 Scaffolding Design and Installation

In actual construction, scaffolding involves significant work volumes and high costs, often including redundant operations. Utilizing BIM technology streamlines scaffolding design, enables effective forecasting of construction risks, facilitates targeted improvement measures, and supports developing more scientific, specialized construction plans[9].

BIMMAKE Civil Engineering Detailing Software enables parametric design of formwork support systems, automatically generating scaffolding plans, sections, elevations, and details while supporting structural verification and solution documentation. Based on specialized formwork/scaffolding construction plans and calculations, the software facilitates modeling of formwork layouts, internal support frames, and external scaffolding. It then proceeds with template design integrated with the main structural model to develop formwork layout plans, ultimately exporting construction drawings and material quantity schedules as illustrated in Table 1.

Table 1 Scaffolding Material Summary

Material Name	Total Quantity	Unit	Weight per Piece/Linear Meter (kg/m)	Total Weight (kg)
Unit Name: Unit 1				
Steel Pipe	186259.05	mm	3.33	624487.89
Safety Net	35043.39	m^2	--	--
Wooden Toe Board	1284.02	mm	--	--
Bamboo Scaffolding Plank	1295.83	m^2	--	--
Lumber	736.72	mm	--	--
Swivel Coupler	24879.00	pcs	--	--
Right-Angle Coupler	13610.00	pcs	--	--
Sleeve Coupler	13610.00	pcs	--	--
Wall Tie	3798.00	sets	--	--

Note: The total quantity of rebar is calculated based on cut lengths of steel bars: L-1200 (2250 root), L-1500 (10760 root), L-1800 (576 toot), L-2000 (1710 root), L-2400 (7296 toot), L-2700 (460 root), L-300 (3173 toot), L-3000 (4284 root), L-4500 (4512 root), L-600 (300 root), L-6000 (18096 root), L-900 (2912 root).

In the software, users select the auto-generate scaffolding function to conduct a 3D visual briefing

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using the BIM model (as shown in Figure 9), which intuitively demonstrates the erection sequence and joint details of scaffolding, thereby reducing briefing complexity. Visualizing scaffolding design and installation enables simulation of erection/dismantling processes, optimizes construction sequences and methods, and enhances collaborative construction management.

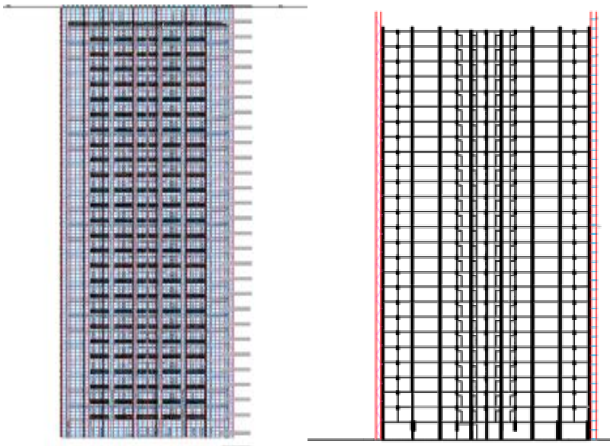

Figure 9 Scaffolding elevation and section views

3.3.2 Formwork Support Detailing

A template detailing design is critical for ensuring structural construction quality and efficiency. First, finalize the formwork and support system drawings as shown in Figure 10. These drawings are then imported into BIMMAKE Civil Engineering Detailing software to model primary formwork supports. Finally, the template design is optimized using Glodon Detailing Software for construction refinement. Design Workflow: First, users create new slab components by setting property parameters, including slab thickness and concrete strength grade, according to project specifications. During drafting operations, users give priority to point-based drawing methods for rapid placement and precise slab positioning. Finally, users execute reinforcement layout: after completing contour drafting, automatically generate main reinforcement or distribution bars using Smart Placement functionality. Concurrently, users leverage the "Apply to Identical Slabs" feature to batch-synchronize parameters for slabs sharing identical properties, ensuring design consistency and enhancing efficiency.

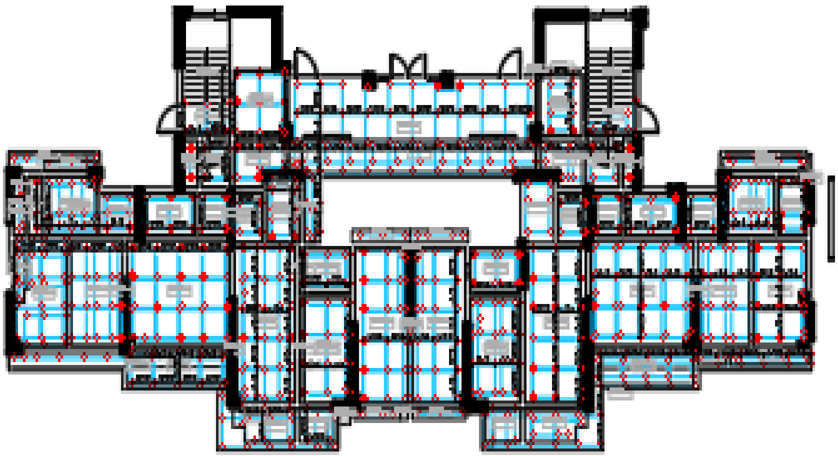

Figure 10 Formwork support layout plan

The software automatically generates formwork layouts based on predefined parameters. Using the 'Quantity Takeoff - Material Statistics' function, it calculates formwork material requirements, providing accurate data for procurement and management. The material summary table for this project's formwork is presented in Table 2. BIM software enables rapid modeling and drawing production for formwork support systems. Compared to traditional drafting methods, this approach achieves precise material quantification, prevents wastage, optimizes construction methodologies, reduces project costs, and significantly enhances drawing production efficiency and accuracy – collectively elevating project controls.

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Table 2 Formwork Material Summary

Floor	Work Section	Element Type	Plyform Spec.	Formwork Area (m^2)	Total Formwork Consumption (Sheets)	Uncut Full Sheet (Sheets)	Initial Full Sheets (m^2)	Cut Sheet Usage (m^2)	Initial Sheet Usage (m^2)	Cutting Utilization Rate (%)	Comprehensive Util. Rate (%)
Unit Name: Unit 1											
L1	Unclassified Construction	Column	1830X915X15	100.47	60	0	0.00	60	71.04	70.71	70.71
		Wall	1830X915X15	1773.24	1059	319	534.15	740	1064.60	85.92	90.16
		Slab	1830X915X15	2844.89	1699	789	1321.14	910	1389.79	91.21	95.29
		Counting	1830X915X15	4718.6	2818	1108	1855.29	1710	2525.43	88.20	92.84
In total (28 floors)			1830X915X15	106070.38	63669	18995	31806.16	44674	63480.23	84.72	89.31

3.3.3 Rebar Node Construction Process

The creation process for Glodon rebar joint models must follow a column-wall to beam-slab-wall framework sequence. Specifically: first create vertical components top-down within the category panel, then edit element graphics for each component type using left-to-right navigation across the horizontal toolbar.

First, users import drawings to identify the level schedule, then configure level settings based on this schedule and the general design notes. Upon completing this setup, they proceed to create grid lines by selecting Drawing B4 for axis network recognition. For shear wall and beam modeling, users begin by performing level-by-level identification of each floor's shear walls while defining and labeling wall reinforcement in the properties interface to final recognition. Following the same level-by-level approach for walls, users subsequently generate beam hanger bars and secondary beam reinforcement automatically within beam components with secondary beam reinforcement editable via Engineering Settings or Calculation Settings - while the visual erection sequence for beams/columns is detailed in Table 3.

Table 3 Beam-Column Rebar Installation Process

Beam-Column Rebar Installation Process	
First, install the column rebar cage. Next, thread and tie the beam's longitudinal bars, add stirrups, align the bars vertically, and secure all stirrup-bar intersections tightly.	
Install the main beam's longitudinal rebars. Mark and place stirrups at the required spacing on the formwork. Finally, insert the bottom longitudinal rebars through the stirrups, checking their position and spacing.	
Install the beam's web reinforcement and top bars. First, place the stirrups, then thread the web reinforcement through them. For deeper beams, add web reinforcement in sections, making sure to fully tie all crossing points with the stirrups around the edges.	

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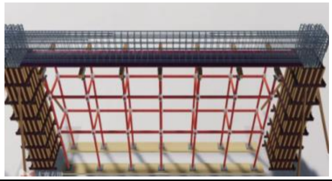
Install stirrups and other reinforcement. When placing stirrups, always install column stirrups first, followed by beam stirrups to prevent installation interference.	

BIM technology enables pre-construction simulation of building methodologies, optimizes rebar placement sequences, mitigates work-at-height risks, and enhances site safety. This approach reduces hazards from improper construction practices at complex joints common in traditional methods while improving operational efficiency.

3.4 Visual Demonstration of Construction Processes Using BIM Technology

Visualization provides an intuitive representation of the designer's intent, enabling clients to comprehensively understand post-construction operational outcomes before groundbreaking. This facilitates effective communication and elevates decision-making efficiency within client organizations. These benefits are fundamentally predicated on visualization capabilities - without this foundation, BIM remains a conceptual framework rather than an implementable methodology[10]. This project utilizes BIMMAKE Site Planning Software's visualization function to create animations. Based on construction drawings and design requirements, 3D models are developed for architectural, structural, MEP, and other disciplines. The completed master model facilitates visual technical briefings that intuitively demonstrate complex construction methodologies and sequences to construction crews. Through annotation components and animation editing tools, critical construction details are labeled and explained to ensure crew comprehension of construction requirements, as illustrated in Figure 11.

Figure 11 Visual Walkthrough

Pre-planned construction visualization models redirect project managers' attention from reactive firefighting of unexpected incidents back to the holistic construction management process. This enables proactive planning and control of construction operations from a system-wide perspective [11]. By integrating 3D models with construction schedules to establish a 4D sequencing model, this project simulates construction processes to demonstrate phase-specific workflows and sequences. Utilizing Glodon's FalconV rendering engine enables photorealistic visualization and high-fidelity walkthroughs that authentically replicate the construction site, thereby providing effective visual technical briefings for enhanced project communication. Through these simulations, construction crews proactively understand methodologies and sequences, reducing field errors and rework while simultaneously optimizing construction plans, enabling evidence-based scheduling, improving operational efficiency, enhancing quality control, and mitigating project risks.

4. Conclusions

Using Wuhan City's Zhongye Shuhua Mingyuan Community complex as a case study, this paper conducts an in-depth exploration of Glodon BIM technology's innovative applications and practical implementations during the construction phase—spanning structural modeling, site layout planning, formwork/scaffolding detailing design, and construction process animation visualization—with conclusions as follows:

1) During the main structural modeling and site layout phases, this project implements Glodon BIM Suite for cloud-based review, enabling design teams to monitor real-time construction progress and

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optimize design workflows. Simultaneously, construction technicians gain clear visibility into ongoing operations, allowing prompt identification of emergent site issues. This dual functionality enhances operational efficiency while advancing digital transformation in construction methodologies.

2) By integrating BIM technology during the construction layout phase, this project enhances site space utilization, shortens project duration, and reduces material transportation costs while enabling dynamic optimization of site management. This approach effectively addresses complex site conditions and hazardous operations, elevating evidence-based productivity and operational efficiency alongside measurable safety enhancement.

3) Integrating BIM models with mobile applications enables real-time documentation and rectification of construction quality issues on-site. Concurrently, BIM technology facilitates visualized simulations of construction processes that mirror actual site conditions, while data-driven construction management delivers digital innovation solutions for the project.

4) BIM models deliver critical value across the entire project lifecycle—from design through operations—ensuring efficient implementation of design intent during construction while guaranteeing master model accuracy. This consequently elevates construction productivity. Utilizing Glodon's BIMMAKE software suite enables stage-specific design refinements during project execution, with real-time construction data integrated into the BIM model. This continuous information flow generates authoritative digital documentation for subsequent inspections, handovers, and operations management.

5) Glodon's BIM technology delivers significant functional enhancements and efficiency gains across design, quantity surveying, construction, and operations phases compared to conventional methods. By enabling integrated design workflows, data-driven construction management, and lifecycle information continuity, this software suite resolves chronic industry challenges—including fragmented information flow, operational inefficiencies, and cost containment difficulties—inherent in traditional project delivery approaches.

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