Application of BIM Technology in Construction Management of Prefabricated Buildings

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***Abstract*—**With the rapid development of the construction industry in China, people have higher and higher requirements for the sustainable development of the environment. As a new building form, prefabricated buildings have the characteristics of standardization, industrialization and efficiency, and have been widely used in the process of engineering construction. The application of BIM technology in the construction management of prefabricated building projects can realize the information integration management of the whole process of prefabricated building construction, improve the cooperative work efficiency of all participants, and give full play to the advantages of prefabricated buildings. This paper expounds the application of BIM technology in the construction management of prefabricated buildings, and discusses the importance of BIM technology.

***Index Terms*—**prefabricated building; BIM technology; Information integration management; Collaborative work

I. INTRODUCTION

The traditional cast-in-place building construction process has problems such as high energy consumption and environmental pollution. Because of its advantages such as environmental protection in the construction process, high resource utilization, short construction period, and good construction environment, prefabricated buildings are attracting more and more attention from government departments. In recent years, various provinces and cities have successively issued policies to promote the development of prefabricated buildings. However, the construction management of prefabricated buildings is more complex, the amount of data information involved is more huge, and the requirements for the on-site installation accuracy of prefabricated components are higher.

BIM (Building Information Model) technology is a kind of information production technology. With the help of BIM model, prefabricated component information can be highly integrated, modular design of prefabricated buildings can be realized, and information communication and collaborative work of all parties involved in the project can be strengthened.

This paper relies on the existing BIM intelligent construction integrated management platform and BIM+Internet of Things technology to effectively solve the current situation of the whole process of prefabricated building construction management at this stage, so as to carry out collaborative management and refined management of data information in the whole process of prefabricated building construction.

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II. PROJECT OVERVIEW

The construction project of Changle People's Hospital is located in Longjin Village, Hangcheng Street, Changle District, Fuzhou City. The above ground building area of the project is 99271.06 m2, the underground building area is 20480.90 m2, and the total building area is 119751.96 m2, consisting of a 24 floor inpatient building, a 5-floor outpatient medical technology complex building and a 1-floor corridor, a 5-floor infectious disease building, a 9-floor logistics support building, a 1-floor diesel generator and substation, a 1-floor hyperbaric oxygen chamber, a 1-floor sewage treatment and garbage station, a 1-floor guard room and inpatient building The outpatient medical technology complex building and corridor are composed of the first underground floor. Among them, the inpatient building and the outpatient medical technology complex building are prefabricated buildings, which are constructed in an industrialized way.

III. CURRENT SITUATION OF PREFABRICATED BUILDING CONSTRUCTION MANAGEMENT

The prefabricated building is the result of the development of building industrialization. The prefabricated components are intensively produced in the standardization plant. After the components are transported to the construction site, the "building block" type assembly construction is adopted, and the prefabricated components are closely connected by the concrete pouring technology. It can reduce the workload of cast-in-situ operation on the construction site and meet the construction requirements of green environment.

In the process of project construction, prefabricated buildings cover many stages, such as design, production, transportation, assembly and construction, and there are massive management data information. Due to the different

contractors involved in the design, production and construction of the prefabricated building construction mode, if the data information at each stage cannot be interconnected and synchronized in real time, it is easy to cause the "information island" phenomenon for the project participants.

There are many types of prefabricated components used in prefabricated buildings. Prefabricated components involve composite plates, beams, columns, stairs and shear walls. A large number of prefabricated components are stacked at the construction site in disorder. How to lift prefabricated components in an orderly and accurate manner in a short time is a management and technical problem that is often encountered in prefabricated buildings at this stage. The installation process of prefabricated buildings is relatively complex, which requires high requirements for construction personnel. In the absence of professional technical training, construction personnel are prone to lack of accuracy in on-site component hoisting, causing construction progress delay and increasing the construction cost of prefabricated buildings. Therefore, through the integration and application of BIM technology and prefabricated buildings, the information management integration of design, production, transportation and construction is realized. Through parametric design, precision production and fine construction, the standardization, standardization and informatization of prefabricated project management process are realized. Comprehensively improve the informatization degree in the project implementation process, promote the advantages of prefabricated buildings to be given full play, and improve the construction efficiency and quality of prefabricated buildings.

IV. BIM TECHNOLOGY APPLICATION ANALYSIS

In the whole process of prefabricated building construction, BIM technology is used, and BIM intelligent construction integrated management platform is used to realize information data sharing and collaborative work of all participants, and the prefabricated component information is stored in the BIM model.

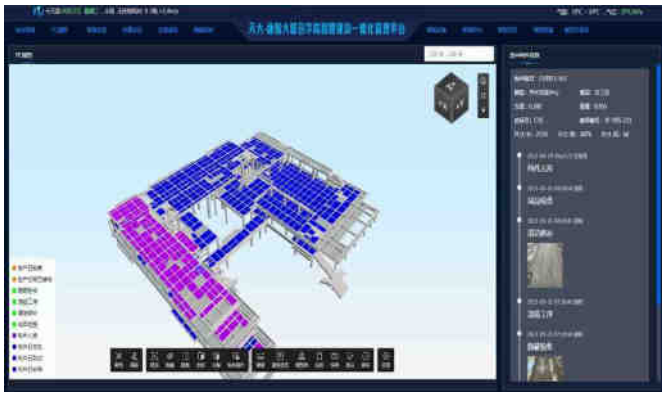

Fig. 1 Intelligent construction integrated management platform

4.1 Design stage

Standardized design is the main development goal of building industrialization. Components are produced in factories to effectively reduce the amount of work on the construction site and improve the construction efficiency [1].

In the design stage of prefabricated buildings, BIM model can be used for modular design. Following the principle of modular coordination, the basic size modulus is preferred in the design of prefabricated components, and the expanded modulus is used locally to reduce the size, specification and type of prefabricated components, so as to facilitate the deepening design, production and processing of prefabricated component manufacturers. It is beneficial to realize the standardization, industrialization and intellectualization of prefabricated buildings and reduce the production cost of components.

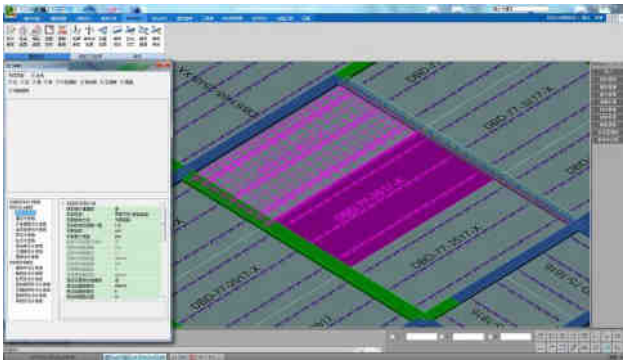

Fig. 2 Component Deepening Design

The installation of mechanical and electrical pipelines and equipment of prefabricated buildings is also a key problem to be solved in the design phase. When creating a BIM model of prefabricated buildings, a comprehensive design should be carried out for the direction of pipelines and the installation position of equipment.

Using the collision check function of BIM software, under the BIM visualization condition, check whether there is collision or conflict between the prefabricated components and the main structure reinforcement or electromechanical pipelines and equipment, and timely modify the collision problems found, effectively improve the design quality of prefabricated components, which can fundamentally improve the design efficiency of designers and the reliability of building models, and can speed up the project progress [2] .

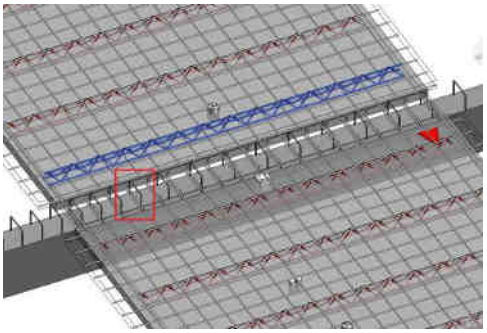

Fig. 3 Reinforcement Collision at Beam Slab Joints

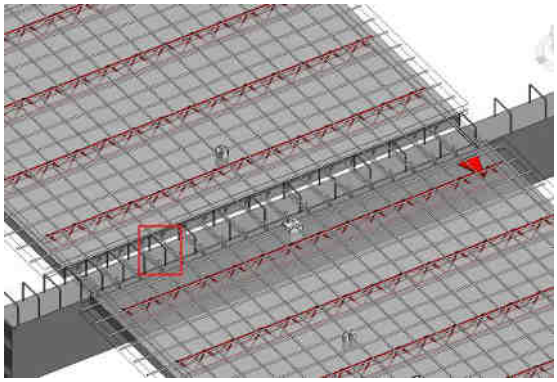

Fig. 4 Reinforcement Collision Optimization at Beam Slab Joints

4.2 Production stage

By using the prefabricated building BIM model, the component production tracking task can be reasonably arranged in combination with the on-site construction progress. Based on the component information tracking function of BIM intelligent construction integrated management platform, after the maintenance of prefabricated components from the production line is completed, the components are placed with two-dimensional code and component information identification, which includes the floor location number, hoisting number, production date and other information of the components.

Fig. 5 Production and transportation of prefabricated components

Fig. 6 Component identification

After the production of prefabricated components is completed, the management personnel can use the mobile terminal of the platform to input the transportation vehicle information, so as to realize the implementation and sharing of information in the component handling and transportation process. The real-time information is helpful for the construction party to make accurate decisions on the construction schedule, and the construction is delayed due to the lack of fabricated components and unnecessary rework.

When the prefabricated components are transported to the construction site, they shall be stacked in batches according to the two-dimensional code identification information. The mobile terminal of the management platform shall be used to identify the component information, record the component transportation, and record the component acceptance, whether it is complete or defective.

4.3 Construction stage

4.3.1 Site planning

Prefabricated components are an important part of prefabricated buildings. In order to avoid possible safety problems in component hoisting construction and ensure orderly and efficient component hoisting, BIM technology is used to simulate the dynamic simulation of prefabricated building structures, simulate the component hoisting construction process, determine the best layout of tower cranes, and reasonably plan the component stacking area and hoisting sequence before the hoisting of prefabricated components.

3.3.2 Construction progress simulation

In order to intuitively and accurately reflect the construction steps and time of the whole process of prefabricated buildings, the BIM model is associated with the construction schedule by preparing the construction schedule and importing the schedule into Navisworks software to achieve the combination of building information model data information and time information to form a visual 4D (3D+Time) model [3]. Through the visualization function of BIM, fully consider the connection between the nodes of the fabricated structure, improve the construction accuracy, and facilitate the technical disclosure of component hoisting to the construction workers.

Fig. 7 Component hoisting simulation construction

V. ANALYSIS OF THE APPLICATION VALUE OF BIM TECHNOLOGY IN PREFABRICATED BUILDINGS

BIM technology and prefabricated building technology are new building methods emerging in the construction industry in recent years, playing an increasingly important role in the construction industry. The application of BIM technology in

the whole process of prefabricated building construction can make up for the shortcomings of prefabricated buildings and improve the construction efficiency of prefabricated buildings. BIM technology makes the design method of prefabricated buildings change from 2D graphic design drawings to 3D building information model design. Designers can establish a database through the building information model to provide data reference for prefabricated building design. In the construction stage of prefabricated buildings, there are often deviations between the design data and the actual construction data, leading to the need for design changes. The BIM technology is used to establish the prefabricated building information model for simulation, which can reasonably plan prefabricated components, avoid conflicts in the construction process, save labor and material costs, and reduce material consumption.

VI. SUMMARY

In recent years, BIM technology has gradually become the key technology of information application in the construction industry. More and more enterprises attach importance to the integrated application of BIM technology in the entire life cycle of prefabricated buildings. The application of BIM technology in prefabricated buildings not only realizes the information sharing and centralized management of BIM models and project data, such as drawings, documents, models, etc., but also improves the efficiency of multi-party collaborative work, and further promotes the exchange and communication of all participants in prefabricated buildings, so as to improve the efficiency of information sharing. It further expands the application ability of BIM technology in the construction site and reduces the application threshold of BIM technology. The BIM application of the project has gradually changed from digital modeling in the design or construction phase to BIM application in the full life cycle, which is conducive to the integrated delivery of the project.

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