Application of BIM technology in a prefabricated complex project

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Abstract: With the development of China's economy, the status of the pillar industry of the construction industry has been highlighted. However, compared with developed countries and regions, the construction industry in China generally has many problems such as large energy consumption, weak management, low level, low profit, and dense personnel. The prefabricated building has entered the public's vision. The prefabricated building has the advantages of energy saving and emission reduction, reducing environmental pollution and high work efficiency. Therefore, the prefabricated building has become an essential construction method for the development of the construction industry. Although the assembly type has many advantages, but the complicated information, complex technology, design refinement and other problems restrict the assembly type technology level in China. Therefore, it is necessary to combine BIM technology to carry out prefabricated component deepening design, daylighting and energy saving analysis, three-dimensional visualization analysis, construction scheme simulation, site layout process analysis, quality process monitoring, etc., to find complex problems in design and construction and conduct visualization research. This paper takes a complex project as an example to carry out the whole process of BIM application in prefabricated building design and construction, which makes the building realize the integrated innovative design of structural system, electromechanical system and prefabricated construction. The maximal adaptability to the space of the complex building is created, resulting in a high quality construction that adds significant value.

1. Introduction
Prefabricated building is a building made of prefabricated components and parts assembled on the site. Compared with traditional cast-in-place buildings, prefabricated buildings have advantages such as fast speed, labor saving and environmental protection. Assembly-type building has the basic characteristics of standardized design, factory production, construction and assembly, integration of decoration, information management and intelligent application. The traditional assembly construction method is the process of engineering design, component design and site construction, which is slow, less optimized, high cost and difficult to control. The complex project structure is complex, the space changes, the specialty diversity, therefore the traditional construction method cannot meet the project needs. With the application of BIM, the previous project cooperation mode has been changed. The participating units can get involved in the project in advance and use BIM technology to carry out site analysis, daylighting analysis, three-dimensional visualization analysis, prefabricated component structural design, indoor natural scenery simulation, outdoor wind simulation, comprehensive building energy saving, etc., in combination with other technology and software. Carry on the data interchange and further carry on the
parameter design and optimization. At the same time, BIM technology can be used to divide modules more reasonably, save purchasing materials, reduce on-site workload, synchronize construction, save time limit and reduce cost. Therefore, it is very necessary and effective to apply BIM technology to prefabricated building projects and comprehensively promote the green, energy saving and intelligence of prefabricated buildings.

2. Project overview
A project is mainly a residential tower and commercial supporting facilities podium building integration construction project, a total area of 12262.71m, aboveground construction area of 61300 m. On the ground, there are four 30-story residential towers and two storeys of commercial facilities. Underground three floors for underground parking and necessary equipment room. Adjacent to the west side of the Shenzhou-Shantou high-speed kengzi exit.

This project is the general contract of design, which applies BIM technology to carry out the forward design of construction drawings, construction and management, and post-maintenance, etc. In order to ensure the effective transmission of the model from design to construction to operation and maintenance in the later stage, all parties involved in the construction jointly formed a BIM team and formulated the corresponding BIM Implementation Plan. The purpose is to ensure the smooth handover of the collaborative models of various specialties in the whole life cycle of the building, and to ensure that the design model can be transferred to the construction stage and the construction deepening model can be transferred to the later operation and maintenance.

3. Deepening design of BIM technology in prefabricated buildings

3.1. Deepening design concept of BIM technology in prefabricated buildings
This design is prefabricated buildings design provided by the construction unit project, for the various prefabricated prefabricated building structure internal installation, mechanical and electrical and the arrangement of the pipeline layout in the design of the detailed plan, make a building component size reasonable, clear, and reserved more accurate positioning of the holes for reinforcement and reserved so that the arrangement of the pipeline layout more reasonable, avoid because of dislocation, the error caused by the problems such as rework phenomenon, improve the quality of engineering of prefabricated construction.

3.2. Deepening design process of BIM technology
Establishment of scheme → 3D modeling → split components → deepening design of components → deepening of complex nodes → model integration → collision inspection → design of supporting components → delivery of drawings.

3.3. BIM prefabricated building construction management
(1) Prefabricated building hoisting simulation
In the deepening diagram, the lifting sequence of components is arranged, and the overall lifting sequence is compiled according to section division. Through the simulation function of PC component construction process, it can verify the interference and collision between components, as well as the conflict between embedded steel bars of components, so as to improve and optimize the construction level and reduce the construction risk, as shown in Fig. 1.
(2) Prefabricated building construction scheme simulation is preferred

According to the particularity of prefabricated building construction, BIM three-dimensional model is used to simulate the construction of the scaffold and the construction of the node core area, etc., to ensure the feasibility of the scheme, as shown in Figure 2.

(3) Quality control of assembled building joints

Aiming at the core area of the joint of the prefabricated building structure, the steel bars of the prefabricated building component are staggered by the steel bars in the joint area through three-dimensional visual reinforcement arrangement to simulate the binding of steel bars. The bolt holes reserved for the formwork of the prefabricated building components are further deepened to guide the field simulation installation and avoid rework, as shown in Fig. 3.
4. Discussion on the application of BIM technology in prefabricated buildings
In order to realize the greening and energy saving of building assembly, the key of adding BIM technology into building projects is to build BIM platform and generate BIM data. This is the key to connecting BIM applications with prefabricated buildings.

The platform built by BIM technology can import the three-dimensional architectural model into the architectural design and software for analysis, and simulate the calculation of sunshine, natural lighting and ventilation, noise prevention and treatment, indoor temperature and humidity, etc. on the platform, so as to realize the green design of prefabricated buildings.

4.1. Site analysis -- BIM+GIS technology
Through BIM+GIS technology, the surrounding environment of the project base is analyzed from a macro point of view in the early stage of the project scheme design, so as to provide spatial inquiry and spatial analysis for the architectural design and basic data for the architectural scheme design, as shown in Figure 4.

4.2. Daylighting Analysis
The indoor lighting analysis of this project adopts the PKPM architectural natural lighting simulation analysis software to analyze and judge the lighting effect of the main indoor functional space and meet the lighting requirements of related buildings, as shown in Figure 5.
4.3. Comprehensive energy saving of buildings
In order to meet the requirements of people's production and life, the requirements of energy saving can be further met under the conditions that the window-to-ground area ratio, visible light transmission ratio, roof and exterior wall structure of the building meet relevant requirements, as shown in Figure 6.

| Serial number | Check item                          | Conclusion          |
|---------------|-------------------------------------|---------------------|
| 1             | Window to ground area ratio         | meet                |
| 2             | Visible light transmittance         | meet                |
| 3             | Skylight type                       | No roof penetration |
| 4             | Roof construction                   | meet                |
| 5             | Exterior wall construction          | meet                |
| 6             | Ventilation opening area            | meet                |
| 7             | Heat insulation inspection          | meet                |
| 8             | Air tightness of exterior Windows   | meet                |
| 9             | Integrated balance                 | meet                |

Fig.6. Comprehensive building energy saving requirements

4.4. Application of Visual Design in 3D Model
The construction of the house mainly includes the design stage, preparation stage, construction stage and so on. Through the combination of 3D model and visualization technology or roaming technology, the building components are presented through software to realize the visual function of the building. Effectively help designers to design construction, construction, heating and ventilation, and avoid secondary construction losses caused by component collisions or human errors, as shown in Figure 7.
4.5. Prefabricated structural design

The structural system of this project is a frame shear wall structure, which has the characteristics of high assembly rate. In the design model, the assembled wall and assembled components are created separately to facilitate the statistics of assembly rate and the separation of assembly components, as shown in Figure 8.

4.6. Electromechanical design of prefabricated components

Pipeline network integrated mechanical and electrical major first guarantees no collision with structure major, and finally achieves no collision with pipelines of each major: as shown in Figure 9. In the BIM model, the data strength of the database reaches the component level, and the statistical function of the material list can improve the efficiency and accuracy of the engineering calculation, which is of great practical significance for cost control and profit guarantee, as shown in Fig. 10.
4.7. Construction organization simulation

Layout of construction site

The BIM technology is used for the overall and reasonable layout and planning of the construction area, material processing area, stacking area, temporary office area, tower crane and so on. Increase the utilization rate of the construction site; Improve the efficiency of artificial and mechanical construction; Maximize economic utilization, as shown in Figure 11.
4.8. On-site application of BIM+VR technology

In the model and sample observation, the most traditional comfort feedback method is to compare the differences between the actual model room and the 3D simulation room. However, adding VR technology to experience the virtual model room, allowing users to experience the interactive touch screen of the all-in-one machine, will greatly reduce the cost of viewing, and can adjust the sample parameters at any time according to the needs of customers, increasing customers' confidence in the owner. Using touch integration to carry on the overall perception of the building and realize the BIM interactive experience of the intelligent chemical industry.

5. Conclusion

The combination of prefabricated building and BIM technology has improved the production level of the construction industry. Make the construction industry more efficient, energy saving, environmental protection. Compared with China's traditional industry, BIM technology is applied. It can realize multi-person operation, improve the efficiency of communication between different professional staff, improve the precision rate of engineering component data, reduce some unnecessary human error, and improve the work efficiency of the whole project. It can be seen that BIM has a very important application value in assembly. It can not only be used in the design of engineering scheme, but also can be used in the simulation of construction, which effectively avoids some problems of collision of steel members. The combination of the two technologies has produced an unexpected spark. Building assembly and BIM technology will be applied in every big city in the country. This integrated scheme is worthy of discussion in the construction industry on its application value, so as to make our country's construction industry have a better development.

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