

Research on the Application of BIM Technology in Prefabricated Building Construction

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Abstract: As an important part of green construction, prefabricated buildings have received strong support from the state, but many problems are easy to occur in practice. BIM technology, as the core of building informatization, can be well integrated with prefabricated buildings. This paper explores the application of BIM technology in prefabricated buildings through the analysis of the status quo of fabricated buildings and BIM technology.

1. Introduction

Applying BIM technology to prefabricated building construction can revolutionize prefabricated buildings, and BIM technology can transform traditional 2D designs into 3D visualizations for deeper design. At the same time, designers can use BIM technology to build inventory models for prefabricated building products, effectively promote prefabricated buildings to achieve factory-scale mass production, and form standardized components. The BIM technology not only promotes the efficiency of prefabricated building design, but also reduces the probability of errors in the design process. It can also improve the mechanization level of prefabricated construction plants and speed up the construction. BIM technology can reduce the workload of returning map modifications, and can use its own software to implement collision checking to determine the location of anomalies. It can effectively reduce the rework and engineering loss caused by wrong design [1]. At the same time, BIM technology can effectively guide on-site construction in prefabricated building construction and calculate the amount of construction work on site. Therefore, BIM technology can effectively promote the development of prefabricated building construction. .

2. The BIM overview and prefabricated buildings

2.1 The connotation of BIM technology.

BIM technology is the building information model construction technology, which needs to integrate various types of construction project information to build a three-dimensional building model. In addition to building a building model, BIM technology is mainly used throughout the life cycle of a construction project and has a collection of information. BIM technology has the advantages of traditional working mode and collaborative management mode. The drawbacks of traditional extensive construction have been changed, and the transition to advanced intensive construction methods has been realized. It has innovated in construction control and visual simulation, and can realize visual effect design, test model renderings, realize 4D effect model design and monitoring functions [2]. The emergence of BIM technology has revolutionized the information technology in the construction industry, and the construction industry has become more refined, efficient and unified. Therefore, BIM technology is known as the most significant technological innovation after CAD technology.

The core of BIM technology lies in the use of computer technology to create a database through 3D virtual technology, to achieve dynamic changes in data and synchronization of building construction status. BIM technology can accurately use the system parameters in the database to speed up decision-making and achieve high-quality projects, effectively reducing costs and capital investment. Finally, the whole process of building construction is controlled, the construction

progress is controlled, resources are saved, costs are reduced, and work efficiency is improved.

2.2 Prefabricated building.

After the parts, construction and raw materials of the building are prefabricated in the production workshop, they are transported to the construction site for installation, and finally the post-casting or slurry anchoring method is used to produce the building products called assembly buildings [1]. The five building types, such as plates, blocks, boxes, ascending slabs, and skeleton plates, are all prefabricated buildings. Because this type of building has a lot of building tonics that have been processed in the workshop, the original cast-in-place work is much lower than the assembly work. Adopting the design of integration of architecture and decoration, the model of modernization of functions, diversification of design, production workshop and construction assembly is formed, and the construction industry is transformed into modern forms such as savings, integration, technology, and environmental protection, in line with the demands of green buildings [2].

3. Advantages of BIM technology applied to quality management of fabricated building construction

BIM is a process of continuously collecting information and visualizing information, shown as below picture. In the process, a platform is established to collect relevant information and display it. It has five characteristics: simulation, coordination, optimization, and visualization. BIM and fabricated building systems are based on components. The introduction of BIM technology in the quality management of fabricated buildings is of great practical significance.

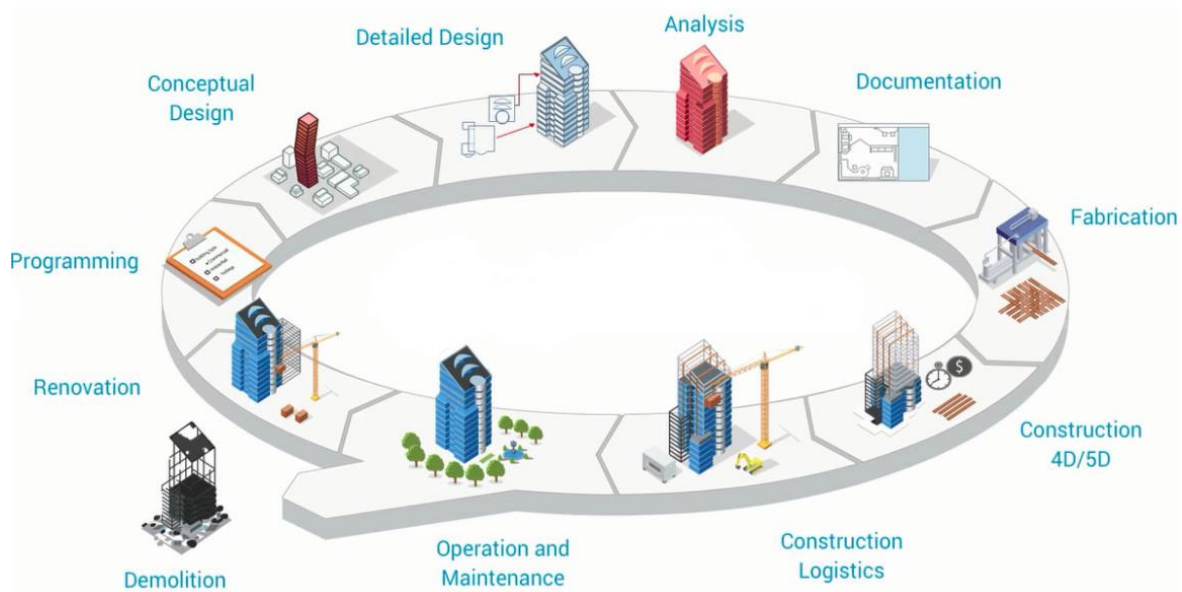


Fig.1 BIM technology applied in building construction

3.1 Improved quality management efficiency.

Prefabricated buildings are different from other forms of construction. In the case of adding BIM to a prefabricated building, the information expression will change greatly. The information expression of past projects is mainly through paper storage and transmission, and the paper is not only easy to damage, but also The efficiency is extremely low, and it is easy to have the problem of “information island“. Moreover, the accuracy of the assembly of the fabricated building is extremely high. If it is simply transmitted through the 2D drawing, not only will a large number of drawings appear in one project, which is not conducive to the organization of the search, and it is difficult to achieve the quality objectives of the construction project [3]. More intuitive understanding of relevant information. Different from BIM, it can build a digital information model to realize 3D visualization. It is not only convenient to store and transfer, but also more intuitive to understand. Through the 3D model display, the precise parameters of each component can be selected.

3.2 Simulate the quality of construction control.

The construction unit can also simulate and analyze the construction plan by using BIM technology, and closely link the time with the 3D model to form a 4D construction model. The appearance of each construction stage is displayed by the model, and then it is compared with the actual construction appearance [4]. The construction quality is tracked in real time, and the difference between the two is analyzed and compared to determine whether there is a quality problem in the construction. Using the building information model of BIM technology, we can accurately know the parameters such as the size and type of each component. All relevant personnel and departments can quickly learn the relevant information, there is no “information island” phenomenon, and the installation process is also transparent disclosure, greatly improving its installation quality and work efficiency.

3.3 Traceability of quality responsibility.

Introduce BIM technology in prefabricated building construction and organically integrate it with the Internet of Things. Through mobile devices, such as Tablet PCs and mobile phones, combined with RFID technology and cloud technology, construction instructors can remotely control and command thousands of miles away. The actual operator, the construction process is supervised [4]. At the same time, by uploading construction-related parameters to the Internet of things, relevant personnel can quickly and easily access relevant construction information, and through real-time recording of various construction links, it is also possible to achieve quality supervision and traceability of the entire construction process.

3.4 Real-time effective control of on-site quality.

The application of BIM model in prefabricated building construction can realize real-time and effective control of quality management, because it can record all the problems occurred during construction and be reflected in the model through the network [3]. The relevant staff can pass observing the model to detect problems that may exist in the construction in a timely manner, so as to quickly find a response method, real-time dynamic monitoring of the project quality can be realized.

4. Problems in quality control of fabricated buildings

In the design stage, the drawing design is the basic link of the building construction and the core part of the quality control. If the mistakes in the design are likely to cause the quality of the building to be unqualified or even lead to serious production accidents, the design drawings and the actual disjointed are easy to appear in the design stage. Designers do not have comprehensive considerations and design optimizations for the operability of components, increasing the difficulty of production and assembly [5]. After the components of each unit are split, it is prone to collision problems. The two-dimensional design is prone to blind spots on the design, and there are information islands that easily lead to collisions between components or inside the building.

During the construction phase, serious misalignment occurred in the construction of the hoisting. On the one hand, the technical level of the operators is not enough, and on the other hand, the supervision and management of the site is not in place. The quality problem caused by the joint connection is mainly that the slurry in the sleeve is not full, resulting in the strength of the joint is not up to standard; when the joint is vertically connected, the sleeve does not match the reserved rib, which makes it impossible to accurately dock during installation; It is more common, because the traditional construction drawings are two-dimensional, which easily lead to node collision problems and easily lead to quality accidents [5]. In the case of temporary support, the verticality of the vertical members does not meet the requirements, which may result in the inconsistency and requirements of the verticality. The insufficient joint strength of the components causes the construction position to deviate, which affects the quality of the project.

5. Application of BIM technology in prefabricated building construction

5.1 BIM technology is used in the prefabricated architectural design phase.

The overall steps of prefabricated building engineering are design, pc component production, and on-site construction. The in-depth design is an important procedure and link of the prefabricated building engineering. In the deepening design, the BIM technology can be used to effectively build the product library and the house type library of the assembled building [6].

The design idea of BIM technology applied to prefabricated buildings is to firstly build prefabricated buildings and standardize them, establish a model library of prefabricated buildings by establishing structural models of prefabricated buildings, and then directly in the process of prefabricated building design. In the model library, select the corresponding components to be applied to the actual engineering project, and use the corresponding BIM software to combine the standard components into a complete 3D model, thereby improving the upgrade efficiency and reducing the probability of design errors [6].

The use of the family is very important in the application of BIM technology to prefabricated building engineering. Therefore, the designer can use the definition of the family to calibrate the functional size and material parameters of the build. In the BIM software, the families are generally divided into three categories, which can be loaded into the family, the built-in family, and the system family. Among them, the loadable family is also called the construction family, which mainly includes structural members, beam plates, doors and windows and other structural members. The build family can be edited separately and can be applied by different projects [5]. It can also form a standardized and modular design structure by extending the software to form a standard family of precast concrete components.

5.2 BIM technology applied to prefabricated components for factory production.

The use of BIM technology can promote the factory production of prefabricated components, which is also an important driving force for residential industrialization. The BIM technology can be used to standardize and modularize the components of the prefabricated house, and build the corresponding family library. In the factory production and construction, the production efficiency of the prefabricated component factory can be greatly improved. For example, we can use BIM software to select different wall sizes in the structural composition according to the purpose, and then prefabricated in the prefabrication factory [7]. The engineering technician can use the BIM technology to accurately control the cross-sectional dimensions of the components, and facilitate the installation of doors and windows, which can fundamentally solve the problem of leakage of prefabricated building doors and windows.

At the same time, the BIM technology can be used to accurately mount metal components. In the traditional metal component construction process, the positioning of the metal is difficult to grasp. Generally, the post-buried method is adopted to add the expansion bolt to the metal component, but this method is easy to cause damage of the component [7]. The BIM technology can effectively solve the conflicting relationship between components and other components. For example, it can solve the conflict between components and reinforced concrete, water supply and drainage pipes, and other embedded parts, and choose the appropriate anchor length to achieve precision.

5.3 BIM technology applied to construction management in prefabricated buildings.

The BIM technology has been widely used in civil engineering construction operations, such as accurately calculating the number of steel bars, accurately calculating the number of concrete works, simulating the crane hoisting, and maintaining the later works. In the field of BIM technology design and construction, the combination of design and construction has emerged [4]. At the same time, AHP can be used to quantify the performance of the construction, the neural network can be used to predict the construction results, and the construction performance can be analyzed and evaluated online.

In the construction management of the site, the constructability is very important to the

construction management. If the problem is found earlier in the early stage, the cost of the correction will be lower, and the project can be guaranteed to complete the work as scheduled [6]. Therefore, construction technicians must pay attention to the constructability of the project and strive to reduce the probability of rework and rework, so as to shorten the construction period and reduce the investment capital of the project.

During the research process, BIM technology has very important value and significance for prefabricated buildings. Because prefabricated buildings are not the same as traditional residential structures, many prefabricated building components are often processed and produced in the factory and finally shipped to the construction site for assembly and assembly. If the prefabricated components used in the on-site construction process conflict in the spatial structure, then the actual demand cannot be met [5]. The final result is to return to the field for adjustment, and even a large number of prefabricated components can not be used, directly scrapped. Therefore, before the on-site prefabricated building construction, the BIM technology can be used to analyze the construction performance of prefabricated components, which can effectively reduce the possibility of rework or redoing of prefabricated buildings, thus saving engineering costs and greatly reducing Engineering risks.

The BIM technology can also effectively plan the work site. If the work site is properly planned, there is a better space configuration, so that the space can be effectively utilized, the work efficiency of the staff can be effectively improved, and the work surface crossover can be avoided. Construction accident. Engineering and technical personnel can use the 3D simulation environment development technology in the BIM software and the planning and configuration technology of the 4d site, and use the dynamic platform of the 3d configuration model to simulate and simulate, which can produce the following effects: the simulation of the 4G terminal can be effectively used by engineers and technicians. Demonstrate all aspects of the construction of the project, and can be combined with the actual project environment; at the same time, engineers and technicians can use the 3D configuration model to effectively allocate resources for each link in the construction process and effectively integrate them [7]. The simulation results of all the sub-projects will finally achieve the best results of the project personnel data, equipment and materials, so as to achieve the purpose of maximizing space utilization, which can effectively improve the efficiency of engineering construction and reduce the cost of engineering investment.

6. Summary

The combination of BIM technology and prefabricated building engineering design and construction can effectively promote the rapid development of prefabricated buildings. However, at this stage, the research work of prefabricated buildings and bim technology in China is still in its infancy, and research and development should be intensified. Intensify, study the advanced experience of developed countries, and gradually put forward their own theories and methods to promote the development of prefabricated buildings.

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References

- [1] Q.W. Jiang, Overview of the development of fabricated concrete buildings at home and abroad, Building Technology, 2014, vol.12, pp.74-77.
- [2] Y.T. Qiu, Engineering Construction Management Revolution Based on Building Information Model (BIM), Joint Construction Management Pioneer, 2011, vol.4, pp.27-30.

- [3] W.J. Gong and C.R. Yang, Design and Optimization of Assembly Component System Based on BIM Technology, Installation and Construction Technology, 2014, vol.1, pp.55-57.
- [4] Zh.K. Wang, BIM-based research and development of prefabricated building design and fabrication technology for prefabricated buildings, China Academy of Building Research, 2018, , vol.3, pp.43-46.
- [5] Y.P. Li and G.P. Chen, Application and Development of BIM Technology in the Design of Prefabricated Concrete Buildings, Concrete World, 2018, vol.6, pp.121-123.
- [6] Y.W. Wang and M.M. Wang, BIM application in prefabricated buildings, Concrete World, 2018, vol.5, pp.39 - 43.
- [7] B.Y. Ji and Zh.Q. Qi, Application Research of BIM Technology in Construction Operation Management, Journal of Beijing Institute of Architecture and Engineering, 2014, vol.10, pp.65 - 67.