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Research on Fabricated Architecture based on BIM Technology

Han Xinyu, Zheng Anna

Shenyang Jianzhu University, School of management, Shenyang, Liaoning, 110168

Abstract: A prefabricated building is a highly integrated product, and the design is the core. At the time of design, each link of the entire industrial chain, such as component processing, construction, maintenance, etc., must be considered, and the three-dimensional refined design of BIM information technology should be used. Based on the BIM technology, this paper comprehensively analyzes the relationship between BIM technology and fabricated architecture and assembly construction, and briefly introduces the establishment process of BIM core component library. Through the application of BIM technology, the prefabricated building will integrate the entire industrial chain to realize the whole process and all-round information integration.

1. Introduction

At present, BIM technology has been widely used in China's construction field. Many construction enterprises or construction units have integrated BIM technology into the construction process of construction projects. For example, the design link of the project plan, the management link of construction materials and the specific construction link, etc. It can be said that BIM technology is an important technical means to ensure the sustainable development of the construction industry. In the process of assembly building design, Chinese construction enterprises have been able to apply BIM technology to various construction links, including production links, design links, construction links and management links, further realizing the effective development of industrial construction projects.

With the introduction of various favorable policies by the central government and local governments at all levels, the assembly-type construction industry has ushered in a golden period of development. Since the Office of the State Council issued the "Guiding Opinions on the Development of Prefabricated Buildings" in September 2016, more than 30 provinces and municipalities across the country have introduced relevant policies for prefabricated buildings. The policy pointed out that during the 14th Five-Year Plan period (2021–2025), the proportion of newly-built buildings in the prefabricated buildings should reach 50% or more; the comprehensively popularized residential buildings will be more than 50% of the newly-built fully-renovated finished residential areas.

2. BIM and Prefabricated Buildings

Prefabricated buildings refer to buildings assembled on the site using prefabricated components, which is an inevitable outcome of the development of social productivity. Prefabricated buildings can achieve three goals: quality controllable, cost controllable, and controllable progress during project development.

Prefabricated buildings are built at a high speed, subject to climatic conditions, saving labor, improving building quality, and protecting the environment. Unlike traditional buildings, the typical feature of a prefabricated building is that standardized prefabricated components or parts are produced



at the factory and then transported to the construction site for assembly and assembly. This means that from the initial stage of design, it is necessary to consider the processing, production, installation, maintenance, etc. of the components, and closely communicate with the structure, equipment, electrical and interior professional in the design process, and carry out the integrated thinking of the whole profession and the whole process. To achieve "standardized design, factory production, assembly construction, integrated decoration, information management."

The building information model is an engineering data model that integrates various related information of construction engineering projects based on three-dimensional digital technology, and is a detailed expression of the relevant information of the project. The information here is not only three-dimensional geometric shape information, but also a large amount of non-geometric information, such as the material, performance, price, weight, location, progress, etc. of the building components.

The introduction of BIM technology integrates the design scheme, manufacturing requirements, and installation requirements into the BIM model, and comprehensively considers various requirements before actual construction, and eliminates problems that may occur in the actual manufacturing and installation process. Similar to the traditional way of using BIM, the BIM application of the prefabricated building facilitates a human-friendly collaboration and a more refined design through visual design. After the introduction of the BIM technology, the BIM component library of the fabricated building is built, and the factory processing can be simulated, and the system integration and expression can be performed in the form of "prefabricated component model". It is understood that the current BIM industry enterprises represented by Pinhao shares are actively building the BIM family library, continuously increasing and enriching the quantity, types and specifications of BIM virtual components, and gradually constructing a standardized prefabricated component library.

The core of the prefabricated building is "integration". The BIM technology is the "integration" method. It connects the whole process of design, production, construction, decoration and management, and serves the entire life cycle of the assembly building. The BIM technology application provides a strong technical guarantee for the prefabricated building design, avoids the traditional two-dimensional design and is prone to problems, realizes the three-dimensional expression of the design, reduces the amount of drawings, and effectively solves the collision problems that may occur between the professional and prefabricated components.

3. Establishment of BIM Component Library

A typical feature of a new fabricated building is that standardized prefabricated components or parts are produced at the factory and then transported to the construction site for assembly and assembly. In the prefabricated construction BIM application, the way of factory processing should be simulated, and the system integration and expression should be carried out in the form of prefabricated component models. This requires the establishment of a BIM component library of the fabricated building. Through the establishment of the assembly building BIM component library, the number, type and specification of BIM virtual components can be continuously increased, and a standardized prefabricated component library is gradually constructed.

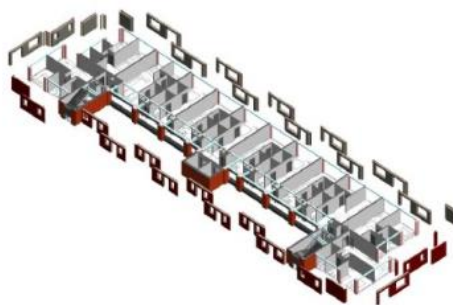


Figure 1 BIM Standardized Design Scheme

1) Construction site organization and process simulation

The construction schedule is written into the BIM information model, and the spatial information and time information are integrated into a visual 4d model, which can intuitively and accurately reflect the construction process of the entire building.

2) Construction simulation collision detection

Through collision detection analysis, it is possible to collect and correct errors and leaks that are not easily detected in the traditional two-dimensional mode. For example, we find that there are potential cross-collision problems between floor heating pipes and electrical pipes through the collision detection of the components inside the prefabricated components.

3) Complex node construction simulation

Through the construction simulation, the complex parts and key construction nodes are previewed in advance, increasing the familiarity of the workers on the construction environment and construction measures, and improving the construction efficiency.

4. Based on BIM Technology Assembly Design

This paper takes Binhe New Home Public Rental Housing Project as an example, applying BIM technology from standard design to management. The building standard modular system is adopted to realize the economical and efficient prefabrication of components, which is convenient for assembly assembly and precise connection with the traditional operation parts. At the same time, it can standardize the specifications of related supporting building materials and parts, and realize the integration of decoration. The standardized and modular design mode realizes the separation of the residential space support system and the filling system, forming an open pattern. It has achieved variable spatial and high adaptability, achieving "100-year residence" and full customer coverage.



Figure 2 Building Standard Modular System

All modules are based on 3m as the reference modulus, and the module size is controlled by the module, which is convenient for the combination of the type and layout.

The BIM module library can be assembled into building models like "building blocks" to provide an intuitive basis for decision making. Through the standardized design of BIM, the types of prefabricated components are greatly reduced. Based on the unified model, the full-scale collaborative design and optimization of the prefabricated building can be realized. The BIM refinement design fully considers the pipeline and other related reserved pre-buried, the refined design of the components minimizes the waste of the steel bars, and realizes the error-free installation of the prefabricated components on site. According to the characteristics of the prefabricated building, rapid engineering quantity analysis is carried out through classification and statistics to achieve initial control of costs. Create different standards of BIM prefabricated component libraries, relying on the standard BIM components in the family library, and "assemble" the design according to the different needs of the owners. The standard BIM prefabricated components meet the requirements of large-scale,

automated machining and efficient assembly on site. The use of BIM technology to perform collision check between prefabricated components and prefabricated components can avoid the “missing and leaking” that is not easily noticeable in traditional two-dimensional design. Demonstrate complex parts and key construction nodes to ensure the feasibility of construction.

1) Building industrialization is a complete system

With the single technology or product-oriented construction industrialization, it is impossible to optimize the types of components, and it is impossible to achieve large-scale production, and it is impossible to achieve efficiency improvement, which does not reflect the advantages of building industrialization.

2) Standardized design is a prerequisite

Projects that are not standardized, modularized, and integrated are not truly industrialized. Taking the “Binhe New Home Public Rental Housing Project” as an example, through standardization and modular design, more than 60% of the component types are optimized, and good social benefits are obtained.

3) Information technology platform based on digital technology is a necessary condition for the development of fabricated buildings

The entire process of information management from design to production, logistics, installation, and post-operation and maintenance has not been realized, and the advantages of industrialization are not reflected.

4) epc management mode is the direction of future industrialization project construction management mode

We should focus on R&D and design as the leader, integrate the whole industry chain resources such as pre-consultation, parts production, installation and construction, project management, adopt the development mode of design, construction and management integration and general contracting, and strive to become the modernization of the construction industry. Key service provider.

5. Conclusion

The BIM technology serves the whole life cycle of design, construction, operation and maintenance, and demolition. It can digitally describe various system elements in a virtual and informatized manner, realize informational collaborative design, visual assembly, interaction of engineering quantity information, and simulation and inspection of node connections. New use. In an era when industrialization elements and information elements are increasingly connected, BIM technology will be perfectly integrated with prefabricated buildings, promoting the innovation of the construction industry and even subverting the traditional construction industry.

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