Research on the application of BIM technology integration method in the design and construction of intelligent building

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Abstract. In the development of modern social construction, in order to guide the development of prefabricated buildings towards intelligence and intelligence, scientific research scholars put forward the integrated application method of BIM technology based on the basic concept of smart construction. In the innovation and development of China's construction industry, prefabricated building design is the most common form. Integrating BIM technology can make a more perfect construction management plan according to the basic characteristics and design requirements of the project, and gradually improve the construction quality of the project. On the basis of understanding the research status of design and construction of intelligent prefabricated buildings, this paper deeply discusses how to use the integration method of BIM technology, and makes clear the application effect of BIM technology with specific cases, so as to provide an effective basis for the sustainable development of the construction industry.

Keywords: Intelligent prefabricated buildings; Architecture design; Construction; Technical BIM

1. Introduction

With the steady development of the construction industry, by defining the design scheme of prefabricated buildings, according to the characteristics of project construction design, and integrating BIM technology, a better building structure can be constructed. Due to the particularity of prefabricated building projects, there will be problems such as insufficient construction level and substandard applied materials during the project construction. If the coordination of construction projects is not done well, the management difficulty of construction projects will easily increase. Nowadays, construction enterprises will define the technical scheme of prefabricated building construction management according to the characteristics of project construction, which can not only guarantee the quality of project construction, but also fully meet the high-quality development needs of the industry. [1-3]In essence, prefabricated buildings are constructed and processed in combination with design drawings, and then transported to the construction site, where hoisting and assembly are completed. From the perspective of practical application, the biggest feature of prefabricated building construction is that on the basis of standardized production, the basic goal of shortening the construction period and green construction is achieved through project coordination, which can further improve the application quality of engineering projects and fully display the technical advantages of prefabricated building construction. BIM technology refers to the building information model. Through the full-cycle analysis of construction projects, special information modules are set by digital technology, and then basic tasks such as design, construction and management are completed according to the module contents, which fully demonstrates the unique value of BIM technology.

Combined with the basic characteristics of prefabricated buildings, the integrated application of BIM technology has the following advantages: on the one hand, it can further improve the quality level of building construction. Using BIM technology to complete assembly construction projects can realize data sharing on the basis of integrating information resources, avoid unnecessary potential safety hazards in construction management, and truly meet the sustainable development needs of the construction industry; On the other hand, it can control the error of construction management. Considering the construction of building structure as a difficult point, on the basis of defining the construction error scheme, in order to further enhance the precision of building structure construction, the three-dimensional view function of BIM technology can be used to help

construction managers to grasp the construction situation more quickly, scientifically coordinate the construction steps, and truly reflect the unique advantages of fabricated building construction. According to the accumulated experience in the design and construction of intelligent prefabricated buildings in recent years, the integrated application of BIM technology has the following problems: First, the industry management standards are not standardized. In the process of project construction management, the construction unit can't integrate and apply new concepts and technologies because of the imperfect legal provisions of prefabricated building construction. Although some areas have clearly recognized the close relationship between BIM technology and prefabricated building construction, there are still some problems such as outdated technology and lack of experience during project management, which directly limits the implementation of intelligent prefabricated building design and construction; Secondly, it is difficult to transport prefabricated components. According to the analysis of the technical characteristics of prefabricated buildings, it is found that in the process of project management, the transportation problem of prefabricated components is often encountered.[4-6] On the one hand, prefabricated building components are special, and the design of application quality and structure size is very critical. On the basis of defining the management plan, the construction unit should set up a scientific construction management plan according to the characteristics of the project to fully meet the innovation and development needs of the industry. However, during the transportation of prefabricated components, various signs are not clear and reserved holes are not standard, which will not only increase the transportation difficulty of the project, but also affect the quality of components. On the other hand, the transportation of prefabricated components will be affected by the management of the construction site, so the construction unit must fully consider the field transportation management of prefabricated components; Finally, the overall coordination technology is not perfect. When fully integrating prefabricated building projects and technologies, it is necessary to put forward a clear construction plan in the process of project management and project coordination. However, due to problems such as imperfect coordination mechanism during technology integration, the practical application has not played an important role, and it will be affected by the market guidance and supervision system, resulting in the lack of in-depth design in prefabricated components, and the construction unit is still dominated by traditional ideas. On the basis of understanding the development status of prefabricated building facilities, according to the main contents of BIM technology, this paper deeply discusses the integrated application scheme in the design and construction of intelligent prefabricated buildings, and makes clear the application performance of BIM technology in combination with practical cases, so as to lay a foundation for the development of prefabricated buildings in China in the new era.[7]

2. Methods

2.1 Platform design

Integrating BIM technology into the whole process of intelligent prefabricated building design and construction requires a technical platform to complete the scheme design. In this paper, BIM technology is used to build a platform, and the 3D building model is introduced into the green building design analysis software, which can finally ensure the development goal of green and intelligent prefabricated buildings. The specific platform design is shown in Figure 1 below:
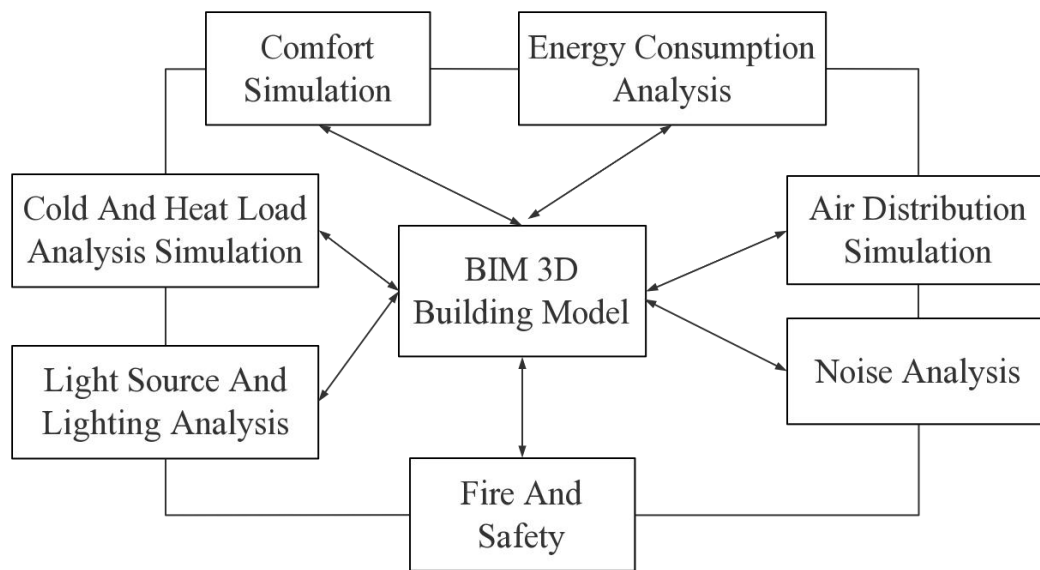
Figure 1 Platform design structure diagram

2.2 Integrated application

According to the development process of computer technology, the design and construction process of prefabricated buildings is divided into three stages: the first refers to the artificial era, the second refers to the keyboard era, and the last refers to the integration era. BIM technology can effectively integrate the whole life cycle data of the project, guide the traditional project construction mode to the integrated project construction mode, and truly realize the design and construction management goal of intelligent prefabricated buildings. The specific transformation process is shown in Figure 2 below:[8-9]
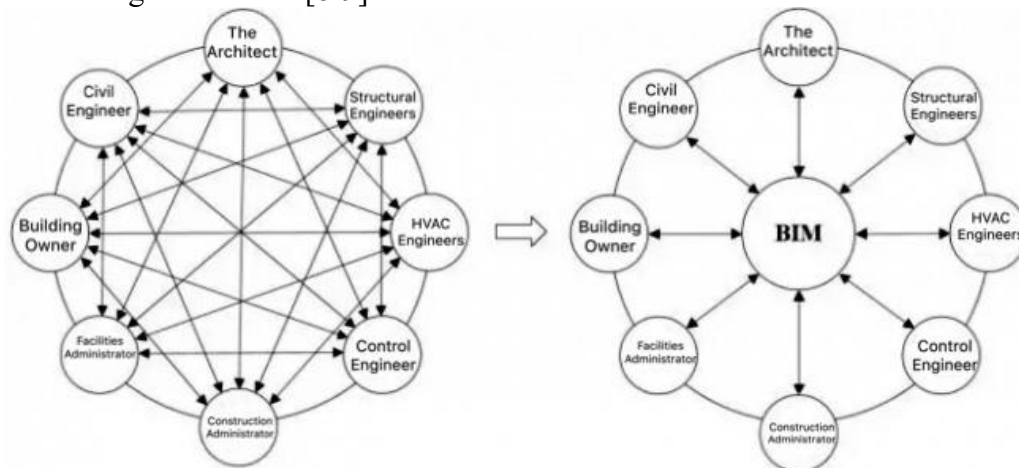

Figure 2 The process of changing from the traditional project construction mode to the integrated project construction mode

2.3 Optimization progress

Combining Navisworks software with the project schedule, the 4D construction model can be used to simulate the construction, gradually optimize the organization structure of the site construction, and make clear the deviation between the planned construction and the actual construction, and finally a better construction scheme can be obtained through comparative analysis. In this process, it is necessary to simulate and analyze the specific progress of the whole project construction, and to assist the field staff to complete the installation task, so as to finally optimize the comprehensive level of construction work.[10]

2.4 Supervision system

Nowadays, there are many problems in the practical work of prefabricated building supervision units, such as lack of information, false information, non-standard acceptance, etc., which not only leads to the supervision units' inability to give full play to their working advantages, but also leads to more construction safety problems. BIM technology can form a set of prefabricated building supervision and control system after secondary development, integrate the data information of each stage of application projects, and provide a standardized and perfect database for construction units. The structure is shown in Figure 3 below:
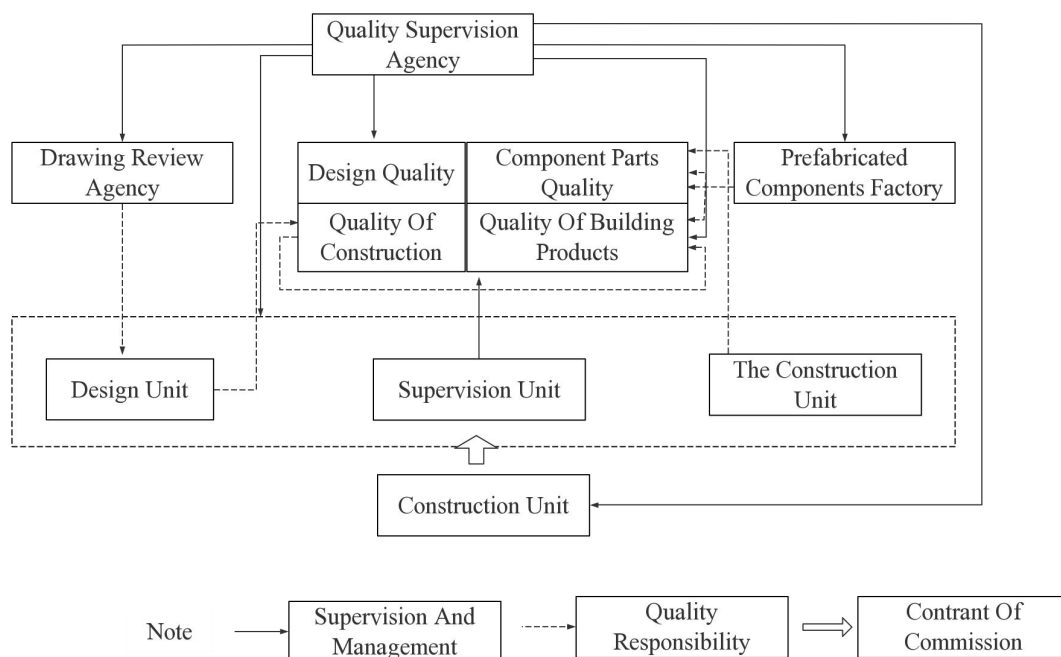

Figure 3 Structure diagram of supervision system of intelligent prefabricated building

According to the above analysis, the units involved in the supervision of the design and construction of intelligent prefabricated buildings include construction units, construction units, supervision units, design units, quality supervision institutions, etc. Among them, supervision units should focus on four aspects: design quality, construction quality, construction product quality, and construction product quality, so as to ensure the safety of the design and construction of prefabricated buildings.[10-13]

2.5 Collaborative management

Technology integration is the core of the design and construction of intelligent building, and the key to realize integration is collaborative management. The application of BIM technology in the design and construction of intelligent prefabricated buildings can optimize the quality and efficiency of building construction, but it is difficult to organically combine all links and participants of prefabricated buildings without strengthening the collaborative management. Now, the construction industry has formed a relatively mature BIM collaborative management software, and the specific process is shown in Figure 4 below:[14-15]
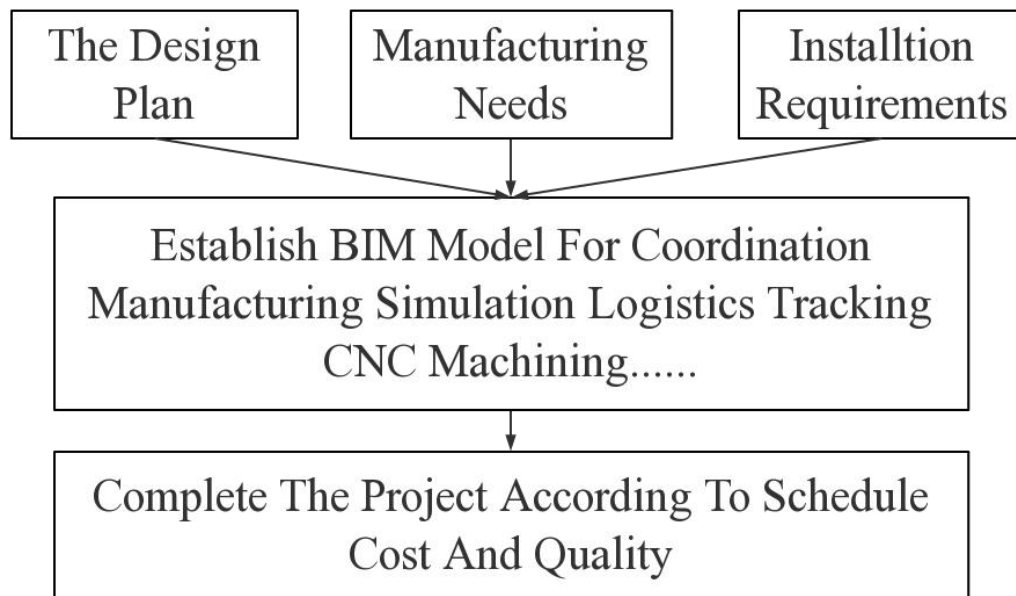
Figure 4 Flow chart of collaborative management

According to the above analysis, the BIM model can be used to make the installation process in advance, quickly find out the existing problems, and effectively solve them to ensure the construction quality of intelligent prefabricated buildings. In the process of production and installation, the integrated use of CNC machine tools, Internet and other technical equipment can quickly optimize the original architectural design and construction mode and fully guarantee the project construction safety in the information tracking and automatic production and manufacturing safety. At the same time, because the information of each link of intelligent prefabricated building construction is complex and the efficiency of resource integration is low, we must consider these problems when integrating and applying BIM technology. Integrate IFC BIM model database, visual editing platform, BIM application software, etc. into the collaborative management system, scientifically set various division rules based on cloud technology, rationally distribute the operating rights of the participating construction management units, and standardize the access and modification of data on the management and control platform, so as to ensure that the stored information flow can be shared in time.

3. Result analysis

Taking the intelligent prefabricated building project in a certain area as an example, the construction enterprise mainly built four office buildings and two restaurants, both of which are connected structures, with the building height of 163 meters and the total area of 61 square meters. Integrating the BIM technology model shown in Figure 5 below to design and construct intelligent assembled steel structure buildings usually faces the following difficulties: First, in the process of comprehensive pipeline layout, problems such as clearance, collision, etc. should be solved to ensure the reasonable and beautiful layout of each position; Secondly, it is necessary to simulate the professional BIM design software to create a digital model for the project construction, and combine MIDAS model to complete the statistical analysis of the engineering quantity and simulate and analyze the construction process at different stages, so as to ensure the feasibility of the construction scheme; Finally, it is necessary to integrate the construction schedule and technology together, quickly identify the required dynamic bill of materials, determine the quantity of material engineering in different stages, and avoid the shortage of resources during the project construction.

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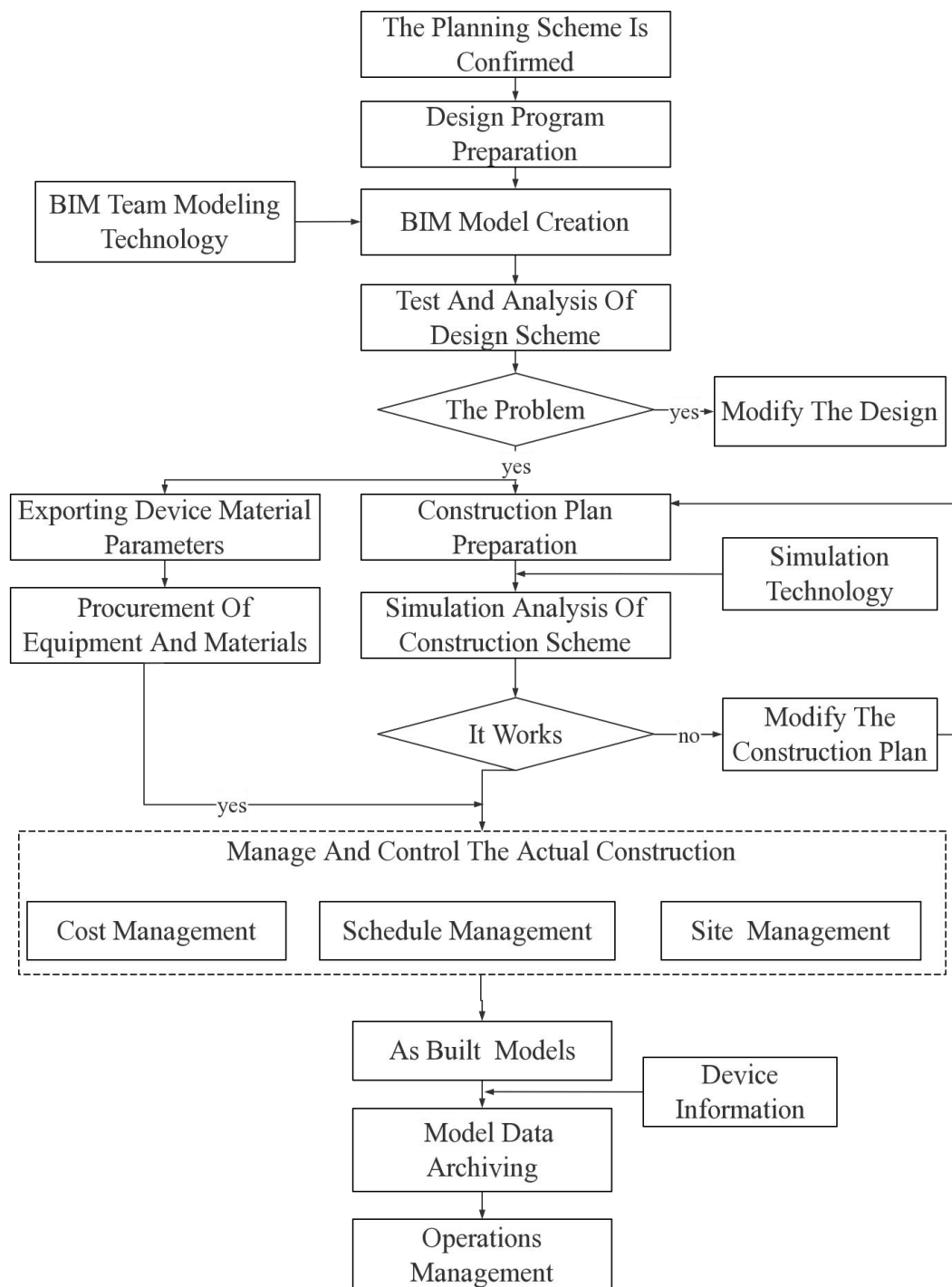
Fig. 5 Flow chart of BIM technology model

Judging from the construction process and final quality of intelligent prefabricated building projects studied in this paper, BIM technology can realize green design management faster, help to avoid excessive consumption of resources, guide the current social construction and development to truly achieve the basic goal of ecological environment protection, and promote prefabricated buildings to truly achieve the development goal of green, low-carbon and environmental protection. Based on BIM technology, the resources of prefabricated buildings can be integrated and utilized, and comprehensive treatment and optimization exploration can be carried out on the collaborative management and control platform, which can further improve the refined management level of construction projects.

Conclusion

To sum up, in the steady development of social economy, science and technology, organically combining the theory of prefabricated buildings and BIM technology, we should not only show three-dimensional models and roaming animations, but also start from all angles of project design and construction management, and strengthen the control of intelligent prefabricated buildings. In the innovation and development of modern society, the integrated application of BIM technology model based on the design and construction of intelligent prefabricated buildings can fully meet the development needs of the construction industry while improving the construction quality. At present, there are few researches on the integration and application of BIM technology, and the professionals and technical means are not mature. However, with more and more scientific research activities, the construction industry has a deeper understanding of BIM technology theory. In the future construction and development, BIM technology will inevitably become an important basis for the development of intelligent prefabricated buildings.

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