Research on Application of Bim Technology in Precast Concrete Structure Design

Minmin Zhu[a,*], Jinghong Wu[b], Lingtao Xia[c], Lili Xu[d]

Department of Construction Engineering, Zhejiang College of Construction, Hangzhou, Zhejiang, 311231, China

[a] 284711269@qq.com, [b]43676803@qq.com, [c] 314221847@qq.com, [d] 929452868@qq.com

*corresponding author

Keywords: BIM Technology, Prefabricated Concrete, Structural Design

Abstract: In recent years, the industrialization system of our country has been gradually improved, and the application of computer technology and information technology in engineering construction has become more and more extensive. As a modern technology based on database and 3D model simulation, BIM technology is very valuable in the popular prefabricated concrete engineering nowadays. This paper briefly expounds the concepts of bim technology and pre-fabricated concrete structure, and then finds out the related application of bim technology, which has the advantages of improving efficiency, reducing cost, promoting the integration of design work and providing management supervision basis. Finally, the practical application of bim technology in prefabricated concrete structure design is studied from the angle of household design, graphic design, facade design and combination design.

1. Introduction

In the field of construction engineering, the application of BIM technology is gradually rising, using this technology can establish the 3D model and related database of related projects on the computer, and then let the engineering designers, constructors, supervisors and other intuitive access to relevant information and data. And prefabricated concrete technology is one of the new technologies in the design and construction of contemporary building engineering. Its application with BIM technology can improve the level of contemporary engineering construction in an all-round way, and the organic combination of the two technologies in the engineering design stage is more worthy of further study.

2. BIM and the Concept of Prefabricated Concrete

2.1. BIM Technology

BIM, that is, building information model. The technology mainly takes the computer software as the carrier, through the 3D simulation and the imaging technology, presents the related information in the virtual model way one kind of technical method. In recent years, the very popular prefabricated concrete structures in the field of construction engineering in China have been developed and applied on the basis of BIM technology. In the project with BIM technology as the leading factor, the simulated 3D model runs through all aspects of engineering design, construction and completion acceptance, and the relevant information and data cover all aspects of the management of the whole process of engineering[1]. This technology can provide intuitive design drawings, reasonable parameter data, and important check and acceptance basis for prefabricated concrete structures. Obviously, through the experience of BIM technology, we can refine the engineering details on the basis of simplifying the work flow, and allocate the engineering materials, technology and personnel reasonably, so as to facilitate the budget and the project cost control work.

  DOI: 10.25236/iccemc.2020.037

2.2. Prefabricated Concrete Technology

Prefabricated concrete technology was developed on the basis of the early assembly of houses. as shown in figure 1, it is the process of dividing a construction project into different structures, processing separately in fixed processing sites such as factories, and then concentrating the structures to the construction site to assemble into buildings. In the application of prefabricated concrete technology, there are high requirements for structural design and treatment of construction engineering, as well as engineering materials. In recent years, under the continuous development of market economy in China, people have put forward higher demands on the buildings used in life and production. The practical application of prefabricated concrete technology can improve the efficiency of engineering construction and reduce the cost of materials and labor at the same time. More importantly, the construction process of prefabricated concrete structure building will not cause great pollution to the environment, and it is very suitable for the construction environment with more complex conditions, which is an advanced technology in line with the current concept of energy saving green building engineering.

Figure 1 A prefabricated concrete structural member

3. The Advantages of BIM Technology in the Design of Prefabricated Concrete Structures

3.1. To Contribute to the Integration of Design and Construction

As shown in figure 2, the application of BIM technology in prefabricated concrete structure design can be very intuitively seen, which can comprehensively enhance the scientific nature and accuracy of the design, ensure that the design scheme conforms to the reality, and provide the construction unit with an intuitive drawing model. At the same time, BIM technology can refine the engineering design scheme and provide guidance for the processing and assembly construction of building components on the basis of 3D model. It is obvious that the combination of BIM technology and prefabricated concrete structure technology can combine engineering design and construction organically, reduce the communication cost of design and construction through the integrated platform of three-dimensional structure model, and ensure that engineering construction meets the design requirements and improves the level of engineering construction[2].

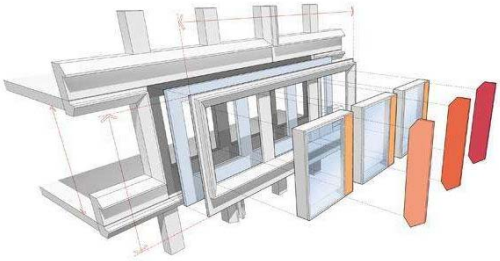

Figure 2 Precast assembly concrete structure based on BIM technology

3.2. To Help Improve Design Efficiency

The application of prefabricated concrete technology itself is to improve the efficiency of engineering construction in an all-round way, and the design stage of adopting this technology is very important. And the design of the project needs to investigate the geological conditions and climate environment of the project site, collect the information data of many aspects, carry out the fine design and issue the construction drawings on the basis of fully understanding the requirements of the owner. In addition, in the design of prefabricated concrete structure, it is necessary to make clear the relevant parameters of prefabricated materials, to carry out scientific calculation of all kinds of data information, and finally to complete the scientific and reasonable architectural design scheme. And the application of BIM technology, can use the computer's powerful computing function and reliable database to collect and organize a large number of data and information, and then use the computer to quickly carry out the construction of three-dimensional model, and then refine the structure design. Finally, the rationality, safety and feasibility of the design scheme can be simulated and checked by using the computer-related physical model, and a more feasible and reliable design scheme of prefabricated concrete structure can be finally completed[3]. In addition, the design team and the project related units can carry on the online real-time information exchange, the different designers can carry on the division of labor synchronous design in the different computer terminals, and finally carry on the summary. Obviously, the whole process can improve the efficiency of prefabricated concrete structure design, which coincides with the application requirements of prefabricated concrete structure technology.

3.3. To Help Improve the Quality of the Project

The construction of 3D model based on BIM technology can achieve the bottom of visual technology. For example, in the hoisting construction of prefabricated concrete structures, the installation workers can intuitively understand the installation mode, structural characteristics and installation requirements through the BIM 3D model. This kind of visual and detailed information model can improve the quality of construction under the premise of ensuring construction schedule and safety[4].

4. The Practical Application of BIM Technology in the Design of Prefabricated Concrete Structures

4.1. Huxing Design for Construction Projects

In the design of prefabricated concrete structure houses, the household type design is of great concern to the buyers and occupants of the house, but often the household type design needs to pay attention to the rationality of the functional zoning, and also pay attention to the difficulty of construction and the consumption of materials. For example, the construction of a certain indemnificatory housing project needs to improve the construction requirements and construction costs on the basis of quality assurance. In the Huxing design of the project, the basic Huxing module and the standard model in the BIM system are used, and then the three-dimensional simulation map of the household type is arranged to form different Huxing simulation maps.

4.2. Graphic Design of Construction Projects

The plan design of the construction project needs to include traffic core, residential function, corridor and so on. On the basis of the Huxing module has been determined, the designer can select the appropriate modules through the BIM model library, and then optimize the size, modulus. It should be noted that the plane design of prefabricated concrete structure needs to consider the difficulty of subsequent construction, as well as the environmental characteristics of the site of the project. For example, for building projects in the northern region, building graphic design needs to reduce the complexity of the external shape and use the inner corridor design as far as possible to balance the lighting and ventilation inside the building.

4.3. Architectural Facade Design

After completing the household and plane design of the prefabricated concrete structure building, it is necessary to carry out the facade design in combination with the construction requirements of the whole project. At this time, designers will generally use the mirror image of the BIM system software, copy the function, the graphic design model is quickly transformed into a three-dimensional model, and then use the appropriate grid to decorate the external facade of the building model mechanical energy to facilitate the reading of the model information.

4.4. Combination Design of Building Engineering Function Modules

When the infrastructure design of the building is completed, the designer needs to design the necessary functional system within the building engineering, which is also a key step in the detailed design of the foundation components of the prefabricated concrete structure. For example, combined with the overall structure of the building engineering and the local terrain, the distribution of public hydropower system, the design of water supply and drainage, HVAC, electrical system inside the building, at this time need to combine the design and construction standards of hydropower engineering to determine the location of equipment in each position of the building, the distribution direction of the pipeline. As shown in Figure 3, the relevant modules in the BIM model library can be combined to form the overall design scheme. Finally, the simulation module in BIM system can be used to simulate the operation of hydropower system to ensure its design rationality[5].

Figure 3 HVAC design model

5. Conclusion

To sum up, the application rate of BIM technology and prefabricated concrete technology is increasing. In the design stage of prefabricated concrete structure, BIM technology can rely on the powerful virtual module system and database system to quickly design and simulate the whole structure and detail construction of the building project. The organic combination of the two technologies will help to improve the design level of the construction project and promote the design and construction work to form an integrated working mechanism, which not only ensures the quality of the project, but also shortens the period of the project and reduces the construction cost of the project. Therefore, it is necessary to further study the BIM technology so as to improve the design level of prefabricated concrete structures and promote the further development of the construction engineering industry.

Acknowledgements

This research has been financed by The second batch of teaching reform research projects in the 13th five-year plan of Zhejiang province “Development and application of the simulation system for assembly structure mapping based on BIM technology”(jg20190831)

References

[1] Zhou Xu. Design analysis of prefabricated concrete structure with BIM technology. China Residential Facilities, no. 9, pp. 63-64,89, 2019.

[2] Li, Zhangcheng. Design method of prefabricated concrete structure based on BIM technology. Construction Engineering Technology and Design, no. 29, pp. 995, 2019.

[3] Chen, Huilei. A probe into the design method of prefabricated concrete structure based on BIM technology. Construction Engineering Technology and Design, no. 28, pp. 4506, 2019.

[4] Xing Dandan. Analysis of prefabricated concrete structure design based on BIM technology. China Residential Facilities, no. 5, pp. 24-25, 2019.

[5] Zhang, Li. Design analysis of prefabricated concrete structures based on BIM technology. Building Materials and Decoration , no. 6, pp. 121-122, 2019.