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Application of BIM Technology in the Construction of Assembly Concrete Structures

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Abstract: This paper introduces the application of BIM technology in the construction of assembly concrete structure. Firstly, the definition and characteristics of BIM technology are elaborated, including its advantages of digitalization, visualization and coordination. Then, it focuses on the application of BIM technology in the construction of assembled concrete structures, including digital management and cooperative work, component production guidance and logistics management. Finally, the importance and development prospect of BIM technology in assembly concrete structure construction are summarized. In order to provide reference for related fields.

Keywords: BIM technology; assembly concrete; construction; application

Introduction

With the continuous development of the construction industry, assembly concrete structure construction has gradually become an important construction method. However, the traditional construction method has many problems, such as information opacity, difficulty in collaborative work, and low precision of component production. In order to solve these problems, BIM technology is gradually introduced into the construction of assembled concrete structures.BIM technology brings many conveniences and benefits to the construction of assembled concrete structures with its advantages of digitization, visualization and coordination.

1 BIM Technology Definition and Characteristics

Definition of BIM technology: BIM (Building Information Modeling) technology is a data-based tool applied to engineering design, construction and management, which is based on three-dimensional digital technology, integrating design information and construction management information of building design, structure, electromechanical, HVAC, water supply and drainage, interior design and other specialties, and providing a collaborative work platform for each specialty. Through BIM technology, designers can create, modify and optimize building models on computers, so as to better realize the visualization, parameterization and intelligence of building design.Features of BIM technology. Through BIM technology, designers can create, modify and optimize the building model on the computer, so as to better realize the visualization, parameterization and intelligence of building design. Characteristics of BIM technology. Coordination: BIM technology can coordinate design conflicts and problems among various specialties and ensure the collaborative work of architectural design, structure, mechanical and electrical and other specialties. Through BIM modeling, designers can discover and solve potential design problems in advance to avoid rework and waste during the construction phase. Parametric design: BIM technology adopts a parametric design method, which can express and organize building elements and components digitally. Designers can adjust the design by modifying the parameters, improving the flexibility and efficiency of the design. Visualization design: BIM technology provides visualization design tools that can present the building model in a three-dimensional form. Designers can better grasp the effect and quality of the building design by observing and adjusting the model. Optimization of design: BIM technology can help designers optimize the building design. By analyzing the performance and interrelationships of building elements, designers can optimize the design scheme and improve the performance and quality of the building [1]. Data management: BIM technology can manage and communicate building design information in a digital way. Designers can extract a variety of data and information through the BIM model, which provides convenience for construction and management.

2 Application of BIM Technology in the Construction of Assembled Concrete Structures

2.1 Deepening Design and Collision Check

The application of BIM technology in the construction of assembled concrete structures, especially in deepening design and collision checking, has revolutionized the construction industry. By using BIM technology, designers are able to better understand and optimize their designs, as well as discover and solve potential problems before construction, improving construction efficiency and quality. Deepening the design is a key component in the construction of assembled concrete structures. Using BIM technology, designers can create 3D models to depict and design every detail in fine detail. This not only gives the designer a more intuitive way to understand and evaluate the design, but also provides detailed guidance for the subsequent construction process.The accuracy and detail of the BIM model can meet or even exceed the accuracy of the actual construction, which provides great convenience for quality control during the construction process. Collision check is another important application in the construction of assembled concrete structures. Through BIM technology, various situations during the construction process can be simulated, and possible problems can be predicted and checked. For example, BIM models can detect clashes between pipes, lines, structural frames, etc., or anticipate whether the connections between components are solid. These collision checking functions greatly reduce the problems that may occur during the construction phase and reduce the possibility of rework and rectification, thus improving the construction efficiency and quality.

2.2 Prefabricated Components Splitting and Optimization

The application of BIM technology in the construction of assembled concrete structures includes prefabricated component splitting and optimization in addition to deepening design and collision checking. In the construction of assembled concrete structure, the disassembly of precast components is a key link in determining the construction quality and efficiency. The traditional way is to split by hand, but this way is not only inefficient, but also prone to errors.The application of BIM technology makes it possible to utilize 3D models to split precast components, and transform the complex structure in the design into steps that can be actually constructed. First, the designer can use the BIM model to simulate the assembled concrete structure, and make a fine design of the shape, size, and connection method of each precast component. Then, according to the needs of construction, the model is split into individual precast components, and this process can be done automatically by computer. Finally, according to the split components, detailed construction plan and material procurement are carried out [2]. At the same time, BIM technology can also optimize the prefabricated components. By simulating the construction process, we can find the problems in the design, such as clashes between components and unstable connections. These problems are hard to be found in traditional 2D design, but they can be easily identified and solved in the 3D model of BIM. By optimizing these problems, we can improve the efficiency and quality of construction and reduce the possibility of rework and rectification.

2.3 Construction Scheme Simulation and Optimization

The application of BIM technology in the construction of assembled concrete structures includes construction scheme simulation and optimization, in addition to deepening design, collision checking and precast component splitting and optimization. Using BIM technology, a digital model of the assembled concrete structure can be constructed and the construction process can be simulated on this basis. Through the simulation, various situations during construction can be predicted so as to better plan and optimize the construction scheme. First, the BIM model can simulate the whole process of construction. From prefabrication, transportation, installation of components to maintenance and dismantling in the later stage, all can be reflected in the model. In this way, we can evaluate the rationality and feasibility of the construction program, as well as predict the problems that may be encountered. Secondly, BIM modeling can simulate special situations in construction. For example, for certain complex construction aspects, such as the connection and fixing of components, the correctness of the construction method can be verified through simulation. In addition, for certain potential problems, such as deformation and cracking of members, they can also be predicted in the simulation. Finally, based on the simulation results, the construction plan can be optimized. For potential problems identified in the simulation, the construction method can be adjusted or the component design can be optimized. At the same time, the simulation can also provide guidance for the construction organization, such as the allocation of personnel, machinery scheduling and construction sequence arrangement.

2.4 Digital Management and Collaborative Work

The application of BIM technology in the construction of assembled concrete structures includes digital management and collaborative work in addition to deepening design, collision checking, precast component splitting and optimization, as well as construction plan simulation and optimization. Digital management refers to the use of information technology to comprehensively manage and monitor the construction process in order to improve construction efficiency and quality. In the construction of assembled concrete structures, digital management can be realized through BIM technology. Through the BIM model, various information in the construction can be comprehensively grasped, including the size, material, weight, and location of the components, as well as the construction progress, personnel allocation, and the use of machinery. This information can be integrated and shared through the digital platform, enabling the various participants to work better together and improve the efficiency and quality of construction. Collaborative work refers to multiple participants working together to accomplish a task. In the construction of assembled concrete structures, collaborative work includes the cooperation of multiple participants such as designers, builders, supervisors, and owners. Through BIM technology, a digital collaborative work platform can be constructed, enabling better communication and collaboration among the participants. For example, the designer can share the design scheme to the constructor and supervisor through the BIM model, the constructor can simulate and optimize the construction scheme according to the model, and the supervisor can supervise and manage the construction process through the model. At the same time, the owner can also understand the construction progress and quality control through the model, so as to better coordinate and manage the whole project.

2.5 Component Production Guidance and Logistics Management

The application of BIM technology in the construction of assembled concrete structure brings a lot of benefits for component production guidance and logistics management. First of all, using BIM model, the design and manufacturing work of molds is more accurate. Designers can determine the shape, size and structure of the mold in detail through the model to ensure that the mold manufacturing meets the design requirements. At the same time, BIM technology can also provide detailed guidance on the use and maintenance of the mold, improving the efficiency of the use of the mold. Secondly, BIM technology can make a detailed production plan of components. According to the construction progress plan and component splitting program, the production sequence and quantity of components can be reasonably arranged to ensure that the production of components is coordinated with the construction progress. This helps to avoid overproduction or underproduction and improve construction efficiency. In addition, the BIM model can record the processing information and quality control data of the components in detail. This helps to monitor and manage the processing accuracy and material quality of the components in real time to ensure that the processing quality of prefabricated components meets the requirements. In terms of logistics management, the application of BIM technology also brings many benefits. First of all, prefabricated components can be coded and tracked through BIM technology, realizing real-time positioning and status monitoring of the components. This helps to ensure a smooth production, transportation and installation process of the components. Secondly, the transportation path of prefabricated components can be planned in detail using BIM technology. By optimizing the transportation route, the transportation time and cost can be reduced and the logistics efficiency can be improved. At the same time, BIM technology can also manage the inventory, real-time grasp of the inventory quantity and location, to avoid the loss of components or repeated reserves. Finally, the use of BIM technology can also optimize the installation sequence of prefabricated components. This helps to ensure the order and rationality of the components in the installation process, avoiding installation conflicts and improving construction efficiency.

2.6 Quality and Schedule Management

Quality and progress management are key aspects in the application of BIM technology in the construction of assembled concrete structures. Utilizing BIM technology, quality and progress management and control can be carried out effectively. For quality management, BIM technology provides detailed quality standards and specifications, which clarify the requirements of each index during the construction process. These standards cover dimensional accuracy of components, material quality, and construction techniques. Through the BIM model, the quality inspection and acceptance data during the construction process can be recorded, including the machining accuracy of the components, welding quality, reinforcement arrangement and so on. By analyzing these data, potential quality problems can be detected in time and remedial measures can be taken quickly. In addition, by utilizing the quality traceability function of BIM technology, the responsible parties and causes of quality problems can be clarified to ensure that the construction quality meets the requirements. In terms of schedule management, BIM technology also has significant advantages. Through BIM modeling, detailed construction plans and schedules can be formulated to clarify the tasks and completion time of each stage, providing clear goals and directions for the construction unit. Real-time monitoring of construction progress, comparing and analyzing the actual completion situation with the plan, helps to find out the progress delay or deviation in time and take corresponding adjustment measures. In addition, the use of BIM technology to optimize the deployment of resources in the construction process and ensure that tasks on the critical path are completed first, helps to ensure the smooth progress of the construction schedule and reduce the waste of resources and increase in costs. At the same time, through the BIM model to identify potential risk factors in the construction process, risk early warning and the development of countermeasures, to help reduce the impact of unforeseen circumstances on the construction schedule, to ensure that the construction is carried out smoothly.

2.7 Post-operation and Support

In the application of BIM technology in the construction of assembled concrete structure, the later operation and maintenance and support is a crucial link. Post-operation and maintenance refers to the management and maintenance process using BIM technology after the building is put into use. First of all, through the BIM model, the utilization condition of the building can be monitored in real time. This includes close observation and analysis of the deformation, cracks, and damage of various components to assess their health. The overall stability of the building can also be monitored to prevent settlement and other issues to ensure the safety and stability of the building. Secondly, using BIM models, it is also possible to record and manage the equipment information and usage conditions of the building [3]. This management can include regular maintenance and upkeep of the equipment to ensure its normal operation and service life. Meanwhile, through BIM technology, we can also monitor and manage the energy usage of the building to optimize energy consumption, reduce operating costs, and improve the sustainability of the building. Post-use support refers to the use of BIM technology to provide support and decision-making basis for the post-use of the building. Through BIM modeling, we can obtain detailed information about the building, including its structure, equipment and system operation. This information can provide important decision support for maintenance, remodeling, expansion, and so on. For example, using BIM technology, we can develop reasonable repair or renovation programs to improve the performance and life span of a building. Also, with BIM models, we can provide decision support for the later use of the building, such as the need for expansion, updating equipment, or energy optimization. In addition, in the event of natural disasters or other emergencies, BIM technology can be utilized to quickly obtain detailed information about the building to support emergency response and post-disaster recovery.

3 Prospect of the Application of BIM Technology in the Construction of Assembly Concrete Structures

With the continuous development and progress of science and technology, the application of BIM technology in the construction of assembled concrete structure will be more and more extensive. In the future, BIM technology will be further applied and developed in the following aspects: firstly, the visualization degree of BIM technology will be higher. Through more detailed modeling technology and richer data information, the BIM model will simulate the construction process and building structure more realistically, providing more intuitive visual effects and more accurate information for designers, constructors, supervisors and other participants. Secondly, BIM technology will pay more attention to collaborative work. In the future, BIM technology will pay more attention to the collaborative work between the participants, through a more intelligent coordination system and a closer cooperation mechanism, the participants will be more closely linked together to achieve more efficient information exchange and collaborative work. Finally, BIM technology will pay more attention to intelligent decision support. Through the combination of big data, artificial intelligence and other technologies, BIM technology will provide more intelligent and automated decision-making support for the participants, helping them to better grasp the construction process and building structure, and improve decision-making efficiency and accuracy.

Conclusion

The application of BIM technology in the construction of assembled concrete structures is of great significance and value. By realizing digital management and collaborative work, BIM technology can significantly improve construction efficiency and quality. Constructing accurate models makes the component production guidance and logistics management more delicate, thus reducing component production costs and optimizing logistics efficiency. These advantages have injected new vitality into the development of the construction industry and promoted the continuous progress of the industry. With the continuous development and improvement of BIM technology, its application in the construction of assembled concrete structures will be more extensive and in-depth, opening up a broader prospect for the development of the construction industry.

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