Analysis on the Application of BIM Technology in Construction Safety Management in Water Conservancy and Hydro Power Projects

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ABSTRACT
Implementing BIM technology in water conservancy and hydro power projects provides more effective information feedback for digital collaborative design and construction. Through BIM technology, typical accidents during the construction process can be simulated, effectively reducing construction risks. In addition, BIM technology can also detect and solve problems promptly, making technical briefings and risk explanations before construction more timely and effective. During construction, you can focus on risk points to avoid safety accidents and improve construction efficiency and quality.

Keywords: *BIM technology, Water conservancy and hydro power engineering, Construction safety management.*

1. INTRODUCTION

Among many large-scale engineering constructions, water conservancy and hydro power projects are considered to be cumbersome and complex because they require highly high safety. The entire project must be repeatedly assessed and tested to build a stable and reliable one. The emergence and development of BIM technology provides more scientific and advanced engineering design, construction management and supervision methods for water conservancy and hydro power project construction. It can supervise and manage the entire life cycle of project construction, providing a comprehensive guarantee for the construction of water conservancy and hydro power projects.

By using BIM technology, the digital multi-faceted collaborative design and construction of water conservancy and hydro power projects can receive more effective information feedback, providing an accurate basis for project verification. Using BIM technology, engineering construction personnel can predict and identify potential problems and risks in engineering construction in advance, such as foundation settlement, soil stability, etc. Through comprehensive 3D modelling and analysis of engineering construction projects, these potential problems can be discovered and solved, thereby reducing construction risks and ensuring the safe construction of engineering projects.

BIM is one of the essential technical means to realise intelligent construction and operation management of water conservancy and hydro power projects. BIM applications can predict and identify potential problems and risks in project construction in advance, which plays an important role and significance in the implementation of projects.

2. BIM TECHNOLOGY IS ESSENTIAL IN SIMULATING CONSTRUCTION ACCIDENTS IN WATER CONSERVANCY AND HYDROELECTRIC POWER PROJECTS

When it comes to the simulation of engineering construction accidents in water conservancy and hydro power projects, the application of BIM technology is critical. Through the simulation and

analysis capabilities of BIM software, the design team can comprehensively assess the risks and problems that may exist during the project's construction process. For example, consider a large dam construction project. The design team used BIM technology to simulate the construction process, paying particular attention to the construction phase of the dam body. They found that in the simulation, some excavators and trucks could collide with the natural terrain around the construction site or other facilities during transportation, resulting in equipment damage or injuries.

Through the BIM simulation, the design team could predict the potential collision risks and tailor the construction strategies and safety measures to minimize the possibility of accidents [1-3]. For example, they re-planned the transportation routes and set up temporary warning signs and safety zones to ensure safety during equipment transportation. In addition, they simulated the activities of people at the construction site. They combined virtual reality technology to affect the experience of high-risk operations and improve workers' safety awareness and skills.

In water conservancy and hydro power projects, especially for complex dam construction projects, the engineering construction accident simulation of BIM technology can help the design team to fully understand the various risks that may be encountered during the construction process so that targeted measures can be taken to prevent accidents from occurring and ensure that the project is safe and smoothly carried out.

3. BIM TECHNOLOGY TO ASSESS RISKS IN WATER CONSERVANCY AND HYDROELECTRIC POWER PROJECTS

BIM technology is essential in assessing risks in water conservancy and hydroelectric power projects. Using BIM software, engineering teams can more comprehensively analyse and evaluate all aspects of engineering projects, thereby effectively identifying potential risk factors. First, BIM technology can simulate and display the engineering project's overall structure and design plan by establishing a digital engineering model, enabling engineering teams to conduct detailed reviews and analyses of engineering projects in a virtual environment to identify possible design flaws or deficiencies. Secondly, BIM technology can help the engineering team achieve conflict detection and collision analysis before construction to prevent possible problems during the construction process. By simulating the process of different construction stages, and the engineering team can promptly identify and resolve potential construction conflicts and problems, thereby reducing construction risks. In addition, BIM technology can also be integrated with other engineering management systems to achieve real-time monitoring and management of project progress, cost, and quality, as well as provide comprehensive risk assessment and management support for engineering projects.

Risk assessment using BIM technology can help design teams identify and avoid potential risk factors. BIM software provides various analytical tools to simulate and assess risks that may arise during construction [3-5]. For example, the impact of natural disasters such as floods, earthquakes, and windstorms on the project can be assessed through simulation and analysis. In addition, risk scenarios such as safety issues, component conflicts, and equipment failures during the construction process can be simulated and analysed. These risk assessment results provide information and a basis for the design team to help formulate corresponding countermeasures and risk management programs. The multi-dimensional data and information integration functions provided by BIM technology also help to effectively carry out the simulation and risk assessment of the engineering construction process. Combining information on construction progress, resource utilisation, material transportation, etc., with the BIM model allows for a more comprehensive simulation and assessment of all aspects of the engineering construction process. This complete simulation and evaluation help the design team fully understand the details and problems of the construction process, develop reasonable construction strategies, and reduce potential risks.

In BIM modelling, it is of great significance to simulate the construction risks, which can cover a variety of possible problems, such as collision, component displacement and safety risks. Through simulation, problems can be identified and solved in time to avoid safety accidents and quality problems, thus improving construction efficiency and quality.

For example, during the construction process, the BIM model can be used to simulate the transportation paths of different equipment to

determine the shortest route and avoid collisions. In the simulation process, the equipment's size, shape, weight and transportation method need to be considered, as well as factors such as the space and facility conditions at the construction site. Through the simulation, possible problems and difficulties encountered by the equipment during transportation can be predicted, and timely measures can be taken to solve them, ensuring that the equipment can arrive at the designated location safely and reduce collisions and damages during construction.

During the dam construction, the BIM model can also be used to simulate the location and deformation of components in various parts of the dam body, predict possible component displacement and deformation, and take measures to avoid and solve problems. At the same time, the BIM model can also simulate safety risks at the construction site. For example, during dam construction, various hazardous factors, such as working at height, electrical equipment, mechanical equipment and personnel, and possible safety risks and accidents can be simulated in the BIM model. Through simulation, safety risks can be identified and assessed, measures can be taken to reduce risks, possible safety accidents and quality problems can be predicted, and timely measures can be taken to avoid and solve problems.

4. BIM TECHNOLOGY CONTROL WATER CONSERVANCY AND HYDROELECTRIC POWER PROJECT SAFETY

Traditional safety management usually relies on the experience of managers, and the identification of hazard sources and the distribution of protective facilities are often based on experience and general regulations. However, with the development of BIM technology, safety management has entered a whole new phase. BIM has data completeness and visualization features, making it uniquely valuable for safety control. Using BIM to construct 3D digital models, we can visualize the site's appearance, safety protection facilities, safety measures, scaffolding, and construction equipment. For example, managers can use BIM models to view a virtual construction site, including the building structure, the arrangement of equipment, and the surrounding environment, to better understand the potential safety risks during the construction process [6-9].

The visualization space of the BIM model changes dynamically as the project progresses as if the construction site has been moved to the computer screen. Through real-time simulation and analysis of the model, we can visualize the working surface's condition and evaluate the functional space's stability and safety in advance. For example, through real-time simulation and analysis of BIM models, managers and engineers can simulate situations during construction, such as working at heights or collisions with mobile equipment, and the safety measures that may be taken.

Based on the visualization characteristics of the BIM model, the safety training process can be simulated by relying on the information model. Managers and employees can interact with the BIM model to gain more intuitive and precise understanding of the construction site conditions and develop feasible safety measures based on the actual situation. For example, through simulation training with the BIM model, employees can simulate construction site conditions, including possible safety risks and countermeasures, thus improving their safety awareness and operational skills.

This kind of safety training based on digital models not only improves employees' awareness of safety risks and their ability to cope with them but also reduces the probability of safety accidents due to human negligence or inexperience, thus further improving the safety and civilization of construction sites.

5. CONCLUSION

The application of BIM technology in water conservancy and hydropower projects has many prospects, especially in the role of safety control, which has attracted much attention. While traditional safety management often relies on the experience of managers, BIM technology provides a new means for safety control through its data completeness and visualization features. By using BIM to build 3D digital models, engineering teams can visualize the construction site, including appearance, safety facilities, measures, and other factors, thus guiding the development of civilized construction management plans and promoting safe and civilized production. The dynamic changes in the BIM visualization space enable the engineering team to assess the working surface's stability and safety in real time and make timely adjustments and preventions. In addition, the application of BIM technology in the safety training process is also critical; through the simulation of information modelling, managers and employees can more

intuitively and accurately understand the site conditions and develop more feasible safety measures. Although the application of BIM technology in water conservancy and hydro power projects is promising, there are still some challenges in the actual application, such as the need to invest a large amount of resources, poor collaboration and communication, data collection and organization difficulties, and the shortage of professionals. Therefore, it is necessary to strengthen the understanding and application of BIM technology, overcome its challenges, and utilize its great potential in water conservancy and hydro power projects to improve construction efficiency and quality, reduce construction risk, and promote the smooth implementation and safe operation of the projects.

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