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Design and Application Research of Building Construction Safety Management System Based on BIM Technology

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Abstract: BIM technology, as an advanced digital modeling technology, has the potential to be widely applied in the field of construction. This study aims to design and apply a construction safety management system based on BIM technology to improve the efficiency and accuracy of construction safety management. Firstly, the technical theory of BIM is introduced, followed by the current status of construction safety management. Finally, a brief analysis and discussion are conducted on how to solve construction safety management problems. Through the design and application of BIM technology in the construction safety management system, the level of construction safety management is improved, I hope this article can bring help to relevant workers.

Keywords: BIM technology; Building construction; Safety management; Early warning mechanism; Emergency response

Introduction:

The construction safety management system based on BIM technology can achieve comprehensive and multi-dimensional safety management, help project teams better identify and evaluate potential safety risks, and develop scientific and effective safety management measures. By optimizing and integrating data on construction information, resources, and processes, the visualization, operability, and collaboration of construction safety can be improved, ultimately reducing the risk of construction safety accidents. Promote the improvement of construction safety management level and make positive contributions to the sustainable development of construction projects and the safety protection of workers.

1. Overview of BIM Technology Theory

Building Information Modeling (BIM) refers to integrating various information of a building project into a unified model through digital modeling. This model includes data on the geometric shape, spatial location, construction, materials, equipment, time, and cost of buildings. Building information modeling technology, as an advanced digital modeling technology, has brought revolutionary changes to the construction industry[1].

2. Current situation of construction safety management

Construction safety management is a key link in ensuring the safety of workers and projects. Currently, people's attention to construction safety is increasing, but they still face a series of challenges and problems.

2.1 The importance and challenges of construction safety management

2.1.1 Complex and diverse construction environments and processes: Building construction involves multiple professions and processes, and the construction environment is complex and ever-changing, bringing complexity to safety management.

2.1.2Information silo and inaccurate data: information silo often exists in traditional construction safety management, and information between various departments cannot be shared and transferred in time, resulting in inaccurate safety data and difficulty in comprehensive assessment and control of risks.

2.1.3 Human factors and awareness cultivation: Most construction safety accidents are caused by human factors, including the safety awareness and training level of workers. Therefore, cultivating good safety awareness and providing effective training have become challenges.

2.2 Problems in Traditional Construction Safety Management

2.2.1 Manual recording and management: The recording and management of security data is usually done manually, which is prone to omissions and errors.

2.2.2 Difficulty in comprehensively evaluating and controlling risks: Traditional methods are difficult to comprehensively evaluate and control safety risks in complex construction environments.

2.2.3 Slow response: Traditional safety management methods mainly rely on manual inspections and post rectification, resulting in slow response and difficulty in timely detection and resolution of problems.

3 Research on the Application of BIM Technology in Construction Safety Management

3.1 Construction safety design

3.1.1Spatial conflict detection: BIM models can present building structures and equipment layouts in three-dimensional form. Through spatial conflict detection, safety hazards and conflicts during the construction process can be detected in a timely manner, and adjustments and optimizations can be made in advance to reduce construction safety risks.

3.1.2 Visual safety planning: BIM models can help visualize the display of construction safety planning, presenting safety requirements, risk areas, safety facilities, and other information intuitively.

3.1.3 Safety simulation and evaluation: Based on the BIM model, safety simulation and evaluation of the construction process can be carried out.

3.2 Safety warning and risk assessment

3.2.1 Real time data collection and monitoring: With the help of sensors and BIM models, real-time data on construction sites, such as temperature, humidity, gas concentration, etc., can be collected for real-time monitoring and early warning. Once an abnormal situation occurs, the system can automatically issue an alarm to remind relevant personnel to take corresponding measures.

3.2.2 Risk analysis and assessment: BIM models can combine construction processes and relevant data for risk analysis and assessment. By simulating the safety risks of different construction stages, potential hazards can be identified in advance and corresponding control strategies can be developed to reduce the probability of accidents.

3.2.3 Multidimensional risk assessment: BIM models can integrate data from multiple dimensions and comprehensively consider the impact of different factors on construction safety[2].

3.3 Construction site safety management

3.3.1Real time collaboration and communication: Through the BIM platform, various departments and relevant personnel on the construction site can collaborate in real time, share information and resources, and improve the efficiency and accuracy of construction safety management. At the same time, the BIM platform can also achieve real-time communication with external parties, timely sharing of construction safety information, and ensuring smooth information flow.

3.3.2 Safety training and education: By utilizing the BIM model, virtual construction safety training and education can be carried out. Through virtual reality technology, simulate real construction scenarios, involve construction personnel in them, and provide safety operation training to improve their safety awareness and skills.

3.3.3 Construction process monitoring: With the help of BIM technology, real-time monitoring and recording of the construction process can be carried out.

3.4 Construction safety training and education

3.4.1 Virtual training environment: With the help of BIM technology, a virtual construction environment can be established, and through computer simulation and virtual reality technology, construction personnel can be trained in safe virtual scenes.

3.4.2 Interactive learning materials: By utilizing BIM technology, interactive learning materials can be created, including videos, animations, demonstrations, etc.

3.4.3 Real time feedback and evaluation: In the process of construction safety training and education, BIM technology can provide a real-time feedback and evaluation mechanism. By simulating the construction process, the system can conduct real-time evaluation of the operations of construction personnel and provide corresponding feedback.

4. Design of Building Construction Safety Management System Based on BIM Technology

Construction safety management is an important task to ensure the safety of workers and the construction process. With the help of BIM technology, comprehensive management and control of construction safety can be achieved. This chapter will design a

construction safety management system based on BIM technology to improve safety management efficiency and reduce safety risks.

4.1 System Requirements Analysis

In the system requirements analysis phase, clarify the goals and scope of the system, and determine user and functional requirements. System requirement analysis module:

4.1.1 User management:

User registration and login: Users can access and manage relevant security information by registering an account and logging into the system.

User Role and Permission Management: The system should support multiple user roles and assign different permissions based on the roles to control user access to system functions and data.

4.1.2 Data collection and modeling:

BIM model data collection and storage: The system should support the import and storage of Building Information Model (BIM), including building geometry, component properties, and safety related information.

Sensor data collection and integration: The system should be able to receive and integrate real-time data from sensors, such as temperature, humidity, gas concentration, etc., for safety monitoring and early warning.

Security Record and Document Management: The system should provide security record and document management functions for storing and retrieving records, reports, and files related to construction safety.

4.1.3 Construction safety analysis and risk assessment:

Security analysis and conflict detection of BIM model: The system should be able to analyze the BIM model, detect security conflicts and hidden dangers during the construction process, and provide corresponding solutions.

Safety risk identification and assessment: The system should support the identification and assessment of safety risks, based on the construction process and relevant data, to help users determine the risk level and take corresponding measures.

Visualization of safety analysis results: The system should provide visualization tools to display the safety analysis results in the form of charts, graphs, or thermal diagrams, making it easy for users to understand and make decisions.

4.2 Data collection and modeling

BIM model data collection and storage: Collect building information model data, including geometric shape, component attributes, and safety related information, and establish a BIM model database.

Sensor data collection and integration: Utilize sensors to collect real-time data on construction sites, such as temperature, humidity, gas concentration, etc., and integrate them into the system.

Security Record and Document Management: Provides security record and document management functions to store and retrieve records, reports, and documents related to construction safety.

4.3 Construction safety analysis and risk assessment

Construction safety analysis and risk assessment are important links in building construction safety management based on BIM technology. By conducting safety analysis and risk assessment of the construction process, potential safety hazards and risks can be identified in a timely manner, and corresponding measures can be taken to control and manage them.

5. Conclusion:

In order to further promote the development and application of building construction safety management systems based on BIM technology, we should strengthen cooperation between the government, industry, and academia, jointly formulate norms and standards, promote technological innovation and research and development, provide training and educational resources, and improve the safety management level and safety culture of the entire industry. I believe that with the continuous innovation and development of technology, building construction safety management based on BIM technology will bring safer, more efficient, and sustainable development to the construction industry.

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