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Application of BIM Technology in Safety Management of Construction Projects

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Abstract: With the development of China's construction engineering industry in recent years, a lot of modern technology has emerged in the technology industry to promote the safety management of construction engineering. BIM technology in the process of guaranteeing the quality and safety of the project, plays an important role, this paper through the analysis of BIM technology in the process of construction management of engineering projects, is how to reflect the project quality management objectives and safety management objectives, through the analysis of the importance of safety management in the construction management work, pointed out that the application of the BIM management process needs to pay attention to the main points from the management of the drawings will be examined, Special construction program management, as well as collision detection, deepening design management and other perspectives, to launch the analysis, targeted to strengthen on-site safety education, improve the skill level of on-site construction personnel and safety awareness, from a variety of perspectives, pointed out that, in the safety management of construction projects, the application of BIM technology considerations, so as to better promote the construction project to achieve the project quality management goals and safety management goals, for reference.

Keywords: BIM technology; Construction engineering; Safety management

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1. Introduction

Safety management is of great significance to the life safety of construction personnel, and as an important component of construction management, its importance is self-evident. In the construction process, construction personnel, as the main body of construction, not only play an important role, but also are the main factor in ensuring construction quality and safety. The safety of construction workers directly affects the happiness of multiple families. Currently, there are some potential hazards on construction sites, such as object strikes, electric shock, and falls from heights. Effective safety management can not only ensure the safety of construction workers but also effectively reduce safety risks and create a safe working environment for them. For example, when working at heights, construction workers are required to use protective measures such as safety helmets, safety belts, and safety nets to effectively ensure their safety.

2. The problems and drawbacks of traditional security management

At present, there are some problems facing traditional security management work. In traditional safety management work, relevant departments often conduct on-site safety management in a traditional way, which can lead to many drawbacks at the construction site. Firstly, technicians lack targeted identification of hazards. In traditional safety management, technicians often adopt a general approach to hazard identification without conducting in-depth analysis based on specific construction projects, construction processes, and construction environments, resulting in the neglect of some potential hazards and posing hidden dangers to construction safety. At the same time, in some complex high-rise building construction projects, there is often a problem of relying solely on a general list of hazards for hazard identification, resulting in the omission of some hazards related to special construction processes and posing safety hazards to the construction site.

Secondly, some technical personnel face considerable difficulties in dynamic management of hazardous sources. Construction is a dynamic process, and some construction conditions and progress are constantly changing, resulting in an increasing number of hazards. In traditional security management work, some technical personnel are unable to handle dynamic changes and find it difficult to grasp the changes in hazardous sources.

Finally, during the construction process, the safety planning of relevant departments is relatively lagging behind, often resulting in one-time safety training before the start of construction, and neglecting the dynamic adjustment and optimization of hazards during the construction process. As construction progresses, new safety issues may arise, making it difficult for technicians to effectively respond [1].

3. Challenges and improvement directions faced by traditional security management models

The traditional safety management mode is facing severe challenges in the current construction environment. Relevant departments need to effectively improve the traditional safety management mode, strengthen the targeted identification of dangerous persons, and combine advanced risk assessment methods and technologies. In the field of construction engineering, the application of BIM new technology can effectively improve project quality, increase the safety and stability of construction projects, and reduce and lower construction risks [2]. In addition, technicians need to increase their supervision of dynamic management of hazards, effectively establish real-time monitoring systems, strengthen the application of information technology, timely discover hazards, and take corresponding control measures to ensure construction safety. Finally, they need to improve the level of safety planning during the construction process, strengthen dynamic analysis and prediction of the construction process, adjust safety planning plans in a timely manner, and better respond to various safety risks.

4. Key points of BIM technology application in construction safety management process

4.1. Drawing review management

In the process of applying BIM technology, technicians need to combine the problems in the drawings to conduct construction analysis, improve the quality and efficiency of the drawing review work, and encourage relevant personnel to combine drawing problems with complex construction problems for analysis. Technicians need to apply BIM technology to predict potential safety issues during the construction process in a timely manner, in order to improve construction quality [3].

4.2. Optimize the management of special construction plans

Using BIM technology for simulation analysis and optimization of construction safety plans can effectively

demonstrate the logical relationship of construction processes, and at the same time, connect special construction plans with on-site construction personnel to timely improve the safety of the construction process. In the process of applying BIM technology, construction personnel should also understand the simulation results of special construction plans to further ensure the feasibility of the construction plans, help construction personnel and on-site workers understand the difficulty of the project, and reduce construction risks.

4.3. Three-dimensional and four-dimensional technology visualization disclosure management

Three-dimensional and four-dimensional technology visualization disclosure management is an innovative engineering management approach. It utilizes three-dimensional or even four-dimensional technology to present engineering design, construction processes, etc. in an intuitive visual form. By creating realistic 3D models, construction personnel can clearly see the engineering structure and the positional relationships of various components. Four-dimensional technology adds a time dimension to dynamically display the construction process, which can improve the understanding of construction personnel, reduce misunderstandings and erroneous operations, effectively ensure project quality and progress, improve the efficiency and accuracy of project management, and promote the development of engineering construction towards a more efficient and intelligent direction. Using BIM technology for technical visualization disclosure can better clarify various processes and construction procedures, clarify the logical relationships between construction processes, and intuitively present the construction site and process using BIM technology. On the BIM technology platform, both graphics and text can be presented in an intuitive way, reducing the difficulty of technical and construction personnel in understanding the technology, ensuring the feasibility of technical disclosure and construction safety, and effectively realizing the value of BIM technology [4].

4.4. Collision detection and deepening design management

Using BIM to deepen models for collision detection can better ensure the quality and efficiency of design and construction projects, and improve the feasibility and guidance of deepening design results. Finally, it is also possible to provide detailed guidance on the on-site construction situation, ensuring safe and precise construction with quality and quantity guaranteed. The use of BIM to deepen models for collision detection is of great significance. In the design and construction of engineering projects, traditional design methods often fail to fully consider the interrelationships between various professional systems, and are prone to various collision problems during the construction process, such as collisions between pipelines and structures, equipment and pipelines, etc. By deepening the collision detection function of BIM models, these potential issues can be detected and resolved in advance during the design phase. In the collision detection process, BIM software can accurately simulate the position and relationship of each component in three-dimensional space, quickly and accurately identify the possible collision areas, and generate detailed reports. Designers can optimize and adjust the design based on these reports, avoiding rework and delays caused by discovering problems only during the construction phase, thereby greatly ensuring the quality and efficiency of the design and construction project [5].

At the same time, the deepening design results after collision detection optimization have higher feasibility and guidance, which can better understand the design intention, clarify the construction sequence, and methods. BIM deepening models can also provide detailed guidance on on-site construction situations. Construction personnel can intuitively understand the specific requirements of each construction process through the model, achieving safe and precise construction with quality and quantity guaranteed. For example, in complex steel structure installation projects, construction personnel can use BIM models to accurately determine the installation position and connection method of components, avoid installation errors, improve construction accuracy and

quality, and ensure the smooth progress of the project.

4.5. Identification and management of hazards

Hazard identification and management is an important part of the entire construction process, and technical personnel need to draw and summarize all production elements and generated components on the construction site into a BIM model. Through BIM technology, model analysis and classification are carried out, and BIM safety analysis software is used to effectively identify hazards. Conduct a thorough evaluation and analysis of hazards, quickly identify potential hazards and safety hazards on site, mark and record construction sites, and clearly output safety analysis reports. Optimize safety BIM models in a timely manner, develop safety construction solutions, and effectively implement on-site safety construction management work [6]. Taking the second phase student apartment of a certain university in Shanghai as a project case, the BIM safety information model of the case was established to verify the operation process of the constructed hazard source management system, and the timeliness, accuracy, and dynamic nature of the system's hazard source information transmission were tested [7].

4.6. Safety planning and management

Technicians can use BIM technology to do a good job in on-site safety planning and management, such as accurately locating safety protection areas, preparing safety plans and safety planning plans, effectively identifying project key and difficult points and construction safety requirements through analysis of on-site construction safety passage openings. At the same time, based on BIM technology, create a good BIM safety protection model, timely reflect and understand the on-site construction situation through the model, optimize safety protection measures in a timely manner, prepare safety protection resource plans, and effectively implement refined management and safety management. The relevant departments need to strengthen the safety planning and management training for construction technicians, further improve the safety management plan, enhance the technical personnel's attention to the safety management of the entire construction site, and thus achieve safety planning and management.

4.7. On-site safety education

Providing safety accident training for on-site construction personnel and effectively carrying out safety education through BIM technology is an important key in the entire application process of BIM technology. Due to potential safety hazards at construction sites and the important role played by construction personnel as the main body of construction, it is crucial to strengthen on-site safety education for them. Traditional safety education methods have certain limitations, making it difficult for construction workers to understand the severity of safety accidents and the importance of mastering safety concepts firsthand. Nowadays, the use of BIM technology can better simulate fire safety evacuation, safe escape, and safe rescue for on-site construction personnel, further breaking through the limitations of safety education. For example, through fire safety evacuation simulation, the layout of passages in various areas can be effectively restored, ensuring that construction personnel have a clear understanding of the spread trend of fire and the direction of smoke diffusion. This can help construction personnel have a clear understanding of fire escape routes and fire safety evacuation points, and improve their ability to respond safely in emergencies. Safe escape simulation can use BIM technology to simulate different types of safety accident scenarios, such as earthquake collapses, ensuring that construction personnel learn to find sturdy shelters during earthquake simulations, avoid being hit by falling objects during collapse simulations, and also ensure that construction personnel learn to use limited space for self-rescue.

By introducing BIM+VR technology to construct building models, observers can not only enter the virtual environment to observe and learn typical work processes, detail nodes, and construction techniques, but also improve design quality through reasonable planning in site layout, achieving the predetermined goal

of environmental protection and efficiency [8]. Safety rescue simulation can cultivate the ability of construction personnel to self-rescue themselves or injured persons after accidents occur. BIM technology can simulate various injury situations, such as fractures, injuries, electric shocks, etc., to help construction personnel use on-site emergency equipment, understand emergency measures, and better improve the safety rescue ability and teamwork spirit of safety personnel. In short, the use of BIM technology can help construction workers visually experience safety accident scenarios, deepen their understanding and memory of safety knowledge, and enable them to master safety response methods through repeated simulation training, thereby improving their practical operational abilities [9]. In addition, BIM technology can also be used to enable multiple people to participate in simulations simultaneously, improving the efficiency and coverage of safety education [10].

5. Conclusion

Overall, the application of BIM technology in construction safety management is crucial. Relevant personnel can summarize and analyze the key points in the application process of BIM technology through safety management, timely improve the technical personnel's application level of BIM technology, strengthen the safety education and management of on-site construction personnel through drawing review management, special construction plans, optimization of management and technology, and the use of visual management and hazard identification methods, improve the various skill levels of construction personnel, effectively ensure the safety of the construction site, and realize the value of BIM technology. In the future, the combination of BIM and artificial intelligence (AI) can be explored to achieve intelligent prediction of safety risks, making project construction more intuitive, construction information more accurate, and making it easier for workers to understand information.

Disclosure statement

The author declares no conflict of interest.

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