Research on the Application of BIM Technology Based on Information Technology in Construction Engineering Safety Management

Shun Li\(^1\)^* , Dong-wei Zhang\(^1\) and Cheng Tian\(^1\)

\(^1\)Hunan Technical College of railway high-speed, Hengyang, Hunan, China

*Corresponding author e-mail: lishun@htcrh.com

Abstract. With the increasing complexity of construction engineering, the traditional construction safety management means and tools have been difficult to meet the actual needs of modern complex construction engineering safety management. It is urgent to adopt BIM Tech as the representative of the safety integrated management tools to realize the systematic management of the construction process. Based on this, this paper first analyzes the main risk factors and problems in the construction safety management, then studies the utilization advantages of BIM Tech in the construction safety management, and finally gives the typical utilization of BIM Tech in the construction safety management.

Keywords: BIM Tech, Construction Engineering, Safety Management

1. Introduction
With the iterative progress of social economy, the social infrastructure construction has achieved significant growth, especially the emergence of various types of construction projects, which requires the safety management level of related construction projects must also be improved, so as to ensure the safety and reliability of construction projects [1]. On the other hand, the iterative progress of computer information tech has obtained extensive and in-depth research and popularization in many fields, especially in the field of construction engineering, which greatly promotes the improvement of construction engineering safety management level [2]. In this context, BIM Tech has been widely and deeply studied for its typical advantages and characteristics of visibility, simulation and optimization.

At present, the utilization of BIM Tech in construction safety management is gradually deepening. The simulation of construction can not only optimize the construction design, but also establish the information system of construction safety management, so as to promote the info management of construction, further realize the transparency of the construction process, and promote the construction process in accordance with the standard process and specifications. Some major construction projects often have several typical characteristics as shown in Figure 1, which makes the safety management of such construction projects have greater challenges and difficulties. The traditional construction safety management means and tools have been difficult to meet the actual needs of modern complex construction engineering safety management [3]. It is urgent to adopt BIM Tech as the representative
of the safety integrated management tools to realize the systematic management of the construction process.

![Diagram](image)

**Figure 1. Typical characteristics of major construction projects**

In addition, from the actual level of the current construction safety management, the factors leading to the safety accidents in the construction stage mainly include the complexity of the engineering difficulty, the lack of attention to the safety management and the relatively backward safety management methods. BIM Tech as an important carrier and platform of construction engineering informatization and industrialization, it not only contains a lot of construction engineering data info, but also can realize the effective simulation of construction engineering, so as to optimize the cost management process of construction engineering. Through the expansion of safety dimension, the improvement of informatization degree and level under BIM Tech significantly promotes the safety management level of construction engineering.

In short, with the help of BIM Tech, the digital expression of the physical and functional characteristics of construction project facilities can realize the informatization of construction safety management, and effectively promote the reform of the construction industry. The visibility, communication and coordination of BIM Tech in the construction safety management can effectively predict the risks in the construction process and promote the smooth flow of info in the process of management communication [4]. With the help of BIM Tech to preview or carry out virtual simulation of construction projects, especially to optimize the deployment of potential problems in the process of construction safety management, so as to better coordinate the operation process of the whole project. Therefore, it is of great practical value to study the utilization of BIM Tech Based on info tech in construction safety management.

2. Main risk factors and problems in construction safety management

2.1. Main risk factors in construction safety management

The construction site of construction engineering, especially the complex construction engineering, has many risk factors related to engineering safety, mainly including people, objects, construction environment and safety management process [5]. Among them, in the aspect of human factors, it mainly includes the safety accidents or hidden dangers caused by the non-standard operation of construction personnel. Statistics show that most of the construction safety incidents are caused by human factors. Secondly, in the aspect of material factors, the materials involved in the construction site mainly include building materials, construction tools and related engineering machinery and equipment. The destructive properties of these substances lay the material premise of the accident. If they are not used in a standard way, they are easy to be dangerous.

In addition, in the aspect of construction work environment factors, it mainly includes social, natural and work environment dimensions [6]. As the most easily neglected factor, construction environmental factors are easy to induce safety accidents. Finally, in the aspect of safety management factors of construction engineering, the construction safety of construction engineering is closely related to the management level. If the construction personnel cannot be effectively managed and educated, it is easy to induce and lead to safety incidents.
2.2. Problems in safety management of construction engineering
The construction process of building engineering has its own particularity, especially the complex structure, volume and load-bearing mechanism of modern buildings, which greatly improves the requirements of structural design, site tech and construction tech [7]. In addition, the construction period of complex construction projects is long, the working environment is relatively bad, and the more complex workload and working procedures make the construction site of construction projects easy to produce safety hazards, as shown in Figure 2 below.

![Diagram](image_url)

**Figure 2. Problems in safety management of construction engineering**

3. Utilization advantages of BIM Tech in construction safety management

3.1. Applicability of BIM Tech in construction safety management
BIM Tech can establish the building info model, simulate the construction process, and realize the comprehensive control and management of the construction stage of the construction project. BIM Tech can realize the integration and sharing of building info, so as to ensure that all construction parties can understand the accurate info of the project in real time and visually. First of all, on the technical level, the 3D modeling of BIM Tech and the effective integration of project schedule, resources and cost can identify the possible safety problems in the construction process in advance. BIM based info sharing and communication in the whole life cycle can promote the unification of data and info standards, and avoid info loss and duplication of labor, aiming at the typical characteristics of complex types, wide sources and scattered storage of construction projects. Secondly, in terms of economic applicability, BIM Tech can produce a huge effect, which can not only greatly reduce the construction cost and cost, but also effectively save the project cycle with the help of conflict detection, and bring greater economic benefits. In addition, in terms of environmental applicability, BIM Tech, as an important platform of construction engineering tech and management informatization, plays a valuable role in safety management.

3.2. Utilization advantages of BIM Tech in construction safety management
First of all, the utilization of BIM Tech in construction safety management can realize the effective identification of hazard sources, especially for the visual management of hazard sources, leak detection and data centralized management. The utilization of BIM in construction project safety plan control covers many processes such as project safety schedule planning, promotion, inspection and evaluation [8]. Through the 3D simulation software to achieve the effective construction of each building info model, and can intuitively show the construction progress of the project in the time dimension [9]. Secondly, at the level of construction project safety planning and optimization, BIM Tech can guide the preparation of safety schedule, carry out in-process safety control and post safety evaluation in real time, and make comprehensive evaluation with the help of the implementation effect of safety schedule.

In addition, at the inspection level of construction safety rules, the organic combination of construction hazard identification and BIM Tech can fully mobilize the advantages of BIM platform visualization, parameterization and info sharing, and improve the efficiency of safety management.
BIM based safety rule inspection can effectively simulate and comprehensively evaluate all aspects of construction, and realize the effective control of architectural design.

Figure 3. Workflow of inspection and design of construction safety rules

4. Typical utilization of BIM Tech in construction safety management

4.1. Spatial planning tech based on BIM
First of all, in the aspect of space-time conflict analysis of construction engineering, BIM Tech can be used to carry out dynamic safety management for the interchange operation in the construction process. Secondly, at the level of collision detection type, it mainly includes equipment pipeline conflict and collision detection, mechanical conflict and collision detection. For example, construction safety analysis of tower crane site selection, collision between construction machinery, and collision between construction machinery and building structure [10]. In addition, the collision detection and process optimization of construction mainly input building model, structural model and mechanical model to generate detection report, including optimizing design scheme and construction scheme.

4.2. Construction site evacuation tech based on BIM
BIM Tech can be well applied to all stages of building life, especially in the construction stage. BIM can establish a real construction site environment, and its virtual construction tech can dynamically show the whole construction process, so as to simulate the model environment required by construction personnel evacuation. With the help of 3D environment simulation generated by BIM, the feasibility and scientificity of construction evacuation process can be verified. With the help of multi-dimensional parametric model and intelligent simulation model, real-time simulation is carried out to ensure the completeness of evacuation info. In addition, at the construction level of construction evacuation environment, through building evacuation scene, setting evacuation personnel and obstacles, the effective analysis of evacuation simulation results is realized.

4.3. Utilization of BIM Tech in safety education and training
With the help of BIM Tech to carry out construction safety education and training, we should first help the construction personnel to be familiar with the internal business and workflow, provide safety education courses with the help of BIM software, and organize and carry out BIM safety education courses. Secondly, construction enterprises should organize and carry out BIM safety education and training to strengthen the cognition of construction process and specification. In addition, from the content level of safety training project, select the appropriate software platform for operation training. Through BIM platform to carry out digital training, promote the sense of safety training site, strengthen the rapid understanding and cognition of construction personnel, reduce their work pressure and reduce the cost of safety management.

5. Conclusion
In summary, The utilization of BIM in construction project facilities entity helps to realize the informatization of construction safety management, promote the visibility, communication and coordination of construction safety management, effectively predict the risks in the construction process, and promote the smooth flow of info in the process of management communication. This paper analyzes the applicability of BIM Tech in construction safety management by studying the main risk factors and problems in construction safety management. Through the analysis of the typical utilization of BIM Tech in construction safety management, this paper studies the specific utilization of BIM in construction site evacuation, space planning and safety education and training.

References
[1] Duanlian. Research on Application of BIM Technology in construction engineering [J]. Sichuan cement, 2019 (10): 128.
[2] Li Haibin, Wang Shuo, Li Jin, yuan Huizhu. Application of BIM Technology in safety production management of Shimao Shenkeng hotel project [J]. Building safety, 2017, 32 (10): 62-64.
[3] Li Tong. Thinking on the application of BIM Technology in construction safety management [J]. Value engineering, 2018, 37 (03): 27-28.
[4] Li Xiaochen. Thinking on the application of BIM Technology in construction safety management [J]. Juye, 2018 (09): 25 + 27.
[5] Liu Yuan. Thinking on the application of BIM Technology in construction safety management [J]. Engineering technology research, 2020, 5 (6): 179-180.
[6] Shang Yanping. Application of BIM Technology in construction safety management [J]. Research on Urban Construction Theory (electronic version), 2017 (27): 52-53.
[7] Shi Baohu. Thinking on the application of BIM Technology in construction safety management [J]. Green environmental protection building materials, 2018 (08): 164-165.
[8] Xie Yimeng. Application of BIM Technology in safety management of architectural decoration construction [J]. Public standardization, 2020, (06): 20, 22.
[9] Yao Zhangli. Application of BIM Technology in construction safety management of building engineering [J]. Building materials and decoration, 2019 (25): 150-151.
[10] Zhang Jiaqing. Application of BIM Technology in construction safety management of building engineering [J]. Green environmental protection building materials, 2020, (03): 207-209.