Research on safety management of building construction Based on BIM and Internet technology

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Abstract

For the construction site complex and changing environment, construction machinery lesions difficult to monitor and difficult to monitor the behavior of workers and other issues, by reason of the construction site construction safety accident occurred, the type of treatment and the investigation and analysis of the construction site defined security zone and division, then combined with BIM, cloud platform and internet technology, proposed BIM-based construction site safety management systems.Take control specification prior, during and after the early warning responsibility to trace the three management methods, construction site, construction machinery, construction workers and managers to provide effective security early warning information, and management measures, use of the Internet security technology for the construction site status of real-time transmission to remote terminals, construction site safety management organizational intelligence, construction safety production of "zero accidents" production targets.

Keywords

Construction Safety Management; BIM; Internet Technology; management methods.

1. Introduction

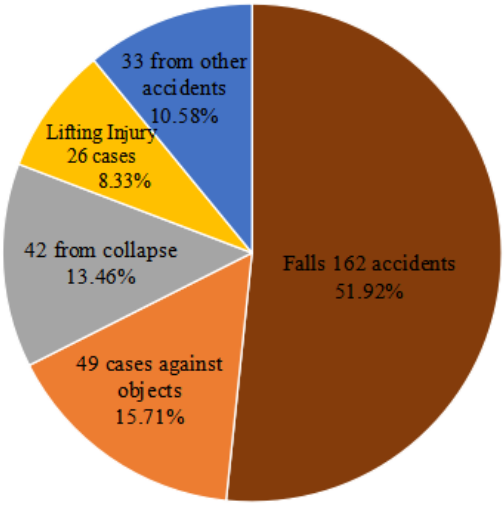
Construction accidents and safety has been a frequent accidents in the industry. This not only makes people's lives and state property suffered enormous losses, a negative impact on the development back to business and industry, and even social stability and economic development have caused a great threat. Therefore, how to effectively improve construction safety management become an urgent problem.

In recent years, established in line with China's national conditions of construction safety management system, but the annual number of deaths due to accidents in the construction of many thousands of people, the direct economic losses each year due to construction accidents caused more than ten billion yuan. How does not affect the rapid development of the construction industry at the same time to ensure construction safety production goals, the rapid development of Internet technology aims to provide a new direction of thinking. BIM (Building Information Modeling) technology is a set of building information model construction project design, construction and operation management provided late, is an applied engineering design and construction management of data tools, integration of related information through various projects parametric model for construction Engineering parties involved in the management units to provide a basis to work together to improve management efficiency [1]. The combination of Internet technology, standardized production workers safe behavior in the construction process, the implementation of dynamic management of the construction process for the construction project management services to provide a safe full life cycle.

2. Traditional construction industry construction site on Safety Management

From the Department of Housing and Urban Construction released data, building construction in our country each year more than 300 accidents, of which 162 falls accidents, accounting for 51.92% of the total; 49 against objects accidents, accounting for 15.71% of the total; 42 collapse, accounting for

13.46% of the total; lifting injuries 26, accounting for 8.33% of the total; mechanical injury, vehicle damage, shock, poisoning and other accidents such as suffocation 33, accounting for 10.58% of the total .



Complex construction environment, construction machinery and unsafe behavior lesions difficult to monitor and workers is the main reason for the above accidents. In this study, committed to BIM and Internet technology to achieve safe production behavior of the construction site for real-time monitoring and safety warning, ensure safety in production "zero accident" the smooth implementation. Construction enterprises to improve the level of management required to optimize the traditional management model, which depends on the combination of the advantages of the Internet to promote the comprehensive development of enterprises. Internet has a comprehensive information application convenient and efficient transmission and other advantages, the advantages of using this information to build a network platform, establish a sound management system will be the new direction for the future development of the construction industry. In this paper, the status quo of the construction safety management, the combination of Internet technology in all walks of life, building construction safety production management services platform from both theoretical and practical applications, and Internet technology by BIM in construction safety management used, that building construction site safety management has been substantially resolved.

3. BIM application background

Currently, the construction industry into the information age, BIM applications have become an important symbol in the construction industry information revolution. BIM technology in the domestic construction industry and academia are more and more attention and application, and gradually become the key technology in the construction industry and the development of industrial transformation and upgrading, is generally considered the construction industry following the CAD after the second revolution [2]. The cloud-based BIM applications have shown a highly efficient, low cost and ease of synergistic advantages. This paper focuses on stage started to explore BIM-based application security management, and to make its development trend.

Beijing Municipal Commission of Housing and Urban-Rural Development promulgated [2015] No.159 "Guiding Opinions on Promoting the building information modeling applications," in reference to its development goals: By the end of 2020, the construction industry Class A survey and design units as well as premium, a housing construction enterprises should master and integrated applications BIM integration with enterprise management systems and other information technology, survey and design of their projects, construction, operation and maintenance, application of BIM integrated project rate of 90% [3]. State-owned investment funds mainly medium-sized buildings, declaration of public buildings and green building green ecological demonstration area builders will use BIM technology. That 2020 BIM technology will be applied to the vast majority of construction projects, and information technology management.

The construction phase of a project is the most important stage, if they can have a molding or a more excellent system that enables fast and easy construction, thereby significantly reducing construction costs and simplify the construction process and thereby improve construction quality, shorten the construction period and reduce accidents. BIM technology appears, it seems to make it all possible.

4. BIM Safety Management Situation

BIM application began in the United States, the United States General Services Administration (General Services Administration, GSA) launched a National 3D-4D-BIM Program in 2003, and have released a series of BIM guidelines [4]. US federal agencies USACE (United States Army Corps of Engineers, USACE) to develop and publish a 15-year (2006-2020) of BIM Roadmap in 2006. Gradually extended to Europe, Japan, Korea and other regions and countries. Statistics show that in 2009 the US Top 300 construction companies more than 80% of the application of BIM technology. Our construction industry since 2003, the introduction of BIM technology, the current application-based company to design, various BIM consulting firms, training institutions, government and industry associations have begun increasing emphasis on the value and significance of BIM.

Based on application of construction safety management BIM and Internet technology is the use of integration of BIM, coordination, simulation and visualization features, ease of planning information communication, coordination, and construction simulation and environments in 3D, 4D model visualization technology down to study the role of BIM in safety management [6]. Internet at the construction site safety management in the use of BIM provides a platform for information exchange and communication, construction site security management can be applied through the development of Internet technology to the actual project, the future will be the new direction of development in the construction industry.

The use of BIM modeling techniques, the establishment of managed objects 3D, 4D model, as well as construction program preview animation, combined with the construction site monitoring of digital surveillance technology, build automation hazard identification system for major hazard construction process to identify and control .

Application of BIM technology planning construction site safety emergency routes, establish a secure system simulation, analysis and observation during construction machines talent, environmental and management factors impact the security situation in the field. Use planning model visualization security plan mode of communication between the construction site staff.

Using virtual reality technology for prevention and control of construction safety and safety assessment programs. Long-term safety of the construction process complex, using virtual reality systems can simulate all kinds as well as possible consequences of the accident, and then develop appropriate preventive measures based on results of the simulation, but also can use virtual reality technology to assess construction safety program effectiveness and economy, determining the most favorable target project integrated the optimal solution.

BIM technology in building construction safety management applications, focusing on BIM in building construction management of application processes, and the use of virtual construction and collision detection to fall and crash safety risks specific management methods studied.

5. Construction BIM Safety Management System

BIM information security management system consists of collection centers, early warning systems, monitoring center, the control center and database constituted. Acquisition Acquisition Center is responsible for the construction site of information, early warning systems of suspicious information to judge and early warning, monitoring center is responsible for the construction of the entire project process, dynamic monitoring, the control center to take urgent measures on the scene of a hazard, avoid further expansion of danger database for the entire project construction project information management and storage corresponding valid information. Each center module coordination work so

that the project to ensure the smooth construction of the project from the design, construction, operation and maintenance of the various stages.

5.1 BIM information collection center

Information BIM information collection center is mainly responsible for the acquisition and construction site safety guidance information, and for other on-site construction and mechanical labeling (a signal reflected annunciator) of its real-time location to determine which is in the danger zone; materials yard and templates scaffolding work area, according to the degree of danger of the work area is divided in hazardous areas, the higher the level, the degree of risk-site construction environment is higher. Field workers are divided into general workers, professionals workers, maintenance workers three kinds of types, different construction area allows workers to enter different types of construction, touch hazardous areas dangerous situation due to different types and different [5]. Cases of falls from a height of construction safety case and identification details as shown in Table 5-1.

Table 5-1 altitude fall danger zones and identifying details

Types of accidents		Hazardous area level			Allowed to enter the type of workers	
		one-level	two-level	three-level	Check eligibility	Check failed
Falls	Gantry installation, use and removal (distance from the edge of gantry)	0.6m-0.8m	0.4m-0.6m	And less than 0.4m	Designed workers	Mainte-nance worker
	Hole limb (limb no fence hole distance)	0.6m-0.8m	0.4m-0.6m	And less than 0.6m	Holder	Mainte-nance worker
	Scaffolding job template (template collapse of the coverage)	High floor within 6.2m	Floor height 6.2m-12.4m	12.4m high floor and above	Holder	Mainte-nance worker
	Removal and installation using a crane (crane foundation in a circle, the radius of the circular area construction crane swept)	Crane work area from a distance of 0.8m-0.6m	Crane work area from a distance of 0.6m-0.4m	Crane from the work area and within a distance of 0.4m	Holder	Mainte-nance worker
	External lift, basket, construction machinery and so on (the lack of recent safety inspection records deemed hazardous area)	Check in time is 1 day- 2 days	Check in time is 2 days -3 days	Check in time is 3days-5 days	Designed workers	Mainte-nance worker

5.2 Early Warning System

① construction site construction machinery, construction materials, etc. appear in the designated danger zone, to the appropriate level of alarm information based on the level of the danger zone, allowed the withdrawal of the security zone; if construction workers and machinery remain in the safe area and more than 5s, then through the monitoring center to the outgoing voice prompts warning system where workers make rapid return safe area, and penalized to violate hazardous area level.

② through the information collection center real-time information collected on-site, on-site construction workers, machinery and other hazardous areas near the construction site, the monitoring

center may issue the appropriate level of alert prompts, enabling field workers to be vigilant in real time.

③ in BIM information collection center for hazardous areas delineated site premise, we want to determine whether the workers in hazardous areas also need to coordinate the position of the space workers. In addition, hazardous area and mechanical-related need for mechanical positioning. Hence the need to introduce early warning model positioning module to achieve human and mechanical positioning.

Early warning systems including signal reception, signal transmission, signal feedback and statistical irregularities four parts. Signal receiving means when the data processing module to discover the location coordinates of workers to hazardous area boundary distance exceeds a certain limit, the module will emit warning label to the worker identification number worn, warning module will start the program after receiving the signal. Signal transmitting means warning module identification number is received, the number corresponding to the label sound and light alarm, sensing danger to workers. It refers to whether the feedback signal after the workers received a warning signal to leave the danger zone. If left stop responding, and vice versa warning module will transmit to the management personnel, including an officer position, number of information, easy to manage security inspectors were dispatched to the scene to view the situation. Meanwhile, early warning module will continue to transmit an alarm signal to the label, the label has been responding until workers from the danger zone so far. Violation statistics means that when workers received a warning signal has not left the immediate danger zone violation will be recorded once, to show the corresponding penalty points.

5.3 Monitoring Center

Monitoring center mainly on the construction site conduct real-time monitoring and data transfer to a safe day generated by the control center, so that the level of on-site safety management can be effectively improved. Collection of data center real-time monitoring, according to the division rule the construction site for hazardous areas as well as construction machinery working arrangement points, piled up points and field supplies all hazards can be detected to detect the early warning system and danger signals to do the appropriate treatment.

5.4 Control Center

Control center according to the project of the size arrangement inspector, responsible for the construction site next to the station's construction safety guidelines and inspections. Control Center will monitor the transfer of data center consolidation, Statistics on the day of unsafe behavior and accidents, the statistics report in written form to sign to confirm the construction side and rectification information notes to the safety control center, and then in the form of push message to the owners, in each operating cycle weekend all field security situation entered into the database, so that you can view real-time information on construction safety construction site, in order to follow-up work on construction safety as a reference guide.

5.5 Database

Data transmission control center each work cycle to the database, the database work can be carried out weekly data filing, according to the needs of the construction side, the database on a weekly units will be required data scrolling on the screen, on-site construction workers View weekly safety scores.

Each of the above parts of the BIM more comprehensive security management system, so that the entire life cycle of the Internet and technology in BIM projects through before, during and after the control enable construction accidents is greatly reduced, effectively reducing construction accidents incidence, protect the safety of construction workers and improve safety image of enterprises, construction safety "zero accidents" goal.

6. Epilogue

Our proposed real-time location for construction site workers and construction machinery, on the one hand by issuing sound to enter the danger zone workers and light alarm, reducing construction site accidents rate; on the other hand can conduct on-site construction safety record, and thus help security managers purposefully safety education, and to improve the ability of the construction site safety.

BIM-based building construction safety management, been able to play a good role, but BIM technology research and application in the country still in the initial stage, technology is not mature enough, more limited range of applications. If you use only during the construction phase will result in the application costs are too high, it cannot reflect the BIM information, collaboration and integration role [6]. In this paper, the application exits on Engineering Construction Safety Management BIM technology many deficiencies, significant limitations, still need to continue to study and improve.

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