

Development and Advanced Technologies of Construction Safety Management

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Abstract. Building construction safety is one of the most important parts of a building construction project, and the use of safety management tools and safe construction techniques can largely achieve the construction industry's requirements for reducing safety production accidents. Safety management, as an important part of the entire construction project, is not only a form of management for enterprises in the construction process but also an important means to maintain the safety of employees, equipment management, and construction progress. Therefore, enterprises in the process of safety management should conscientiously implement the production safety responsibility system, make reasonable personnel allocations for on-site construction management, develop safety management programs by the actual construction conditions, and carry out safe production and construction according to the law. Safety construction technology, as an important means to ensure the safety and quality of construction, is as important as safety management. Technical means are developed to strengthen and improve the main body of the building, ensure the safety performance of the building and eliminate the solution of possible safety hazards, and meet people's requirements for the building's safety quality. It can be seen that construction safety is not a single safety requirement. However, an essential basis for the industry and society to examine the quality of building construction, so only the cognitive implementation of the concept of construction safety can ensure the safety quality of building construction and the economic interests of enterprises.

Keywords: safety management, building operations, safety in production.

1. Introduction

Construction is one of the important carriers of social security in China. With the rapid development of China's economy and the people's increasing demand for quality of life, construction safety has become the primary consideration for people to build buildings. With the increasing development of the construction industry, construction safety accidents are also increasing, according to the analysis of the construction safety accident investigation reports of various provinces and cities in China in recent years. It indicates that construction safety is the primary concern in a construction project [1].

In the process of construction, different construction stages have different requirements for construction safety. Many factors affect construction safety, including force majeure and the impact of cross-operation on construction in the construction process, the safety management of enterprises, construction safety management at the site, and the safe operation of construction personnel. Therefore, many studies focus on construction safety, such as conducting well-established policies and developing safety technologies to ensure the smooth completion of construction. And thus, the life safety of construction personnel and the economic interests of construction projects are guaranteed. This study analyzes the safety of construction from two aspects of construction safety management and construction safety technologies.

2. Construction safety management policies

2.1. Current policies and problems

For the process of safe production, China has the corresponding laws and regulations on safe production, and the regulations on safe production management of construction enterprises shall conform to the Regulations on Reporting, Investigation and Handling of Production Safety Accidents (Decree of The State Council No. 493), which requires "people-oriented, safety first" in the construction of enterprise safety culture management. Moreover, in order to achieve the purpose of safe production, construction enterprises should clarify the requirements of safe production management, implement safety education and training, and strictly control the order of safe production

Today, there are still many problems in the process of construction safety management. First is safety management personnel. In construction, the site safety management personnel are not professional enough to seriously manage the site safety production. Most of the management personnels have low education and professional level, and they are easy to make mistakes in operation. For example, the Fei Cui Huating "4·25" construction accident in Hebei Hengshui City was primarily caused by irresponsible site safety management personnel. The irresponsible personnel did not find the construction elevator safety risks in time, leading to the chaos of site safety management, eventually causing the lift car to fall and accident damage.

Secondly, personnel management policies are not organized. Often the distribution of personnel responsibilities at construction sites is unfair, and there is not many relevant personnel who can be full-time responsible for safety inspection in construction sites and cannot cover the whole construction site to carry out safety inspection and safety supervision. In such a case, people on the construction site cannot sufficiently prevent safety production accidents, and the rate of safety accidents cannot be effectively reduced.

In addition, construction is variable and mobile, different buildings and stages have different safety management requirements, and the construction materials and techniques required in the construction process are also different [2]. Therefore, in the face of such a diverse environment, there are many loopholes and drawbacks in relying solely on safety management regulations. Such a single management model cannot account for the entire construction process, and the sustainability and replicability of safety management are too poor to be an effective guarantee of construction safety. For example, the "08.13" bridge collapse accident in Phoenix County, Hunan Province was because the preliminary design unit's survey work was not meticulous enough, and its design depth and design briefings were insufficient. In addition, the construction unit seriously violated the laws, regulations, and technical standards related to bridge construction and did not consider the site's environmental impact. The construction site management was chaotic, which eventually led to the accident.

Moreover, many non-compliant industry rules are also affecting the safe development of the construction industry. For example, some micro and small construction in place malicious bidding disrupt the market order, the construction management process is not standardized, and construction materials are replaced with bad. In China's complex and changing social environment, these behaviors are important factors that indirectly affect the development of safety management in the construction industry. Both the industry and practitioners can not immediately solve these safety management problems completely, but only by adjusting the safety management-related programs to adapt to the environment, to alleviate the huge pressure on the development of safety management in the construction industry.

2.2. Potential solutions for personal management

The enterprise should strengthen the construction enterprise safety management, and establish a complete safety management system, to ensure the normal operation of safe production. First of all, construction enterprises in the process of safety production should pay attention to safety management. Relevant leaders and responsible personnel should implement the safety management program and

the safety responsibility system effectively. It is suggested to implement safety responsibilities to individuals, actively carry out safety education and training for enterprise employees, cultivate employees' safety awareness and improve their knowledge of safe production. Only to ensure that enterprise employees have good safety awareness, enterprises have a complete and implemented safety management system, which can implement the process of safety production management, maximize the role of safety management, and ensure that construction carried out smoothly [3].

For personnel management, enterprises should reasonably consider the personnel allocation system in construction projects, without a shortage of on-site safety management personnel and confusion in the distribution of responsibilities. By the regulations on production safety management, construction units should be equipped with a corresponding number of safety management personnel. The managers should combine the actual construction status of the construction project to allocate the tasks of safety management, and must ensure that the safety management of the entire construction project can be fully covered. And in special operations, managers should confirm that the operators have qualified qualifications, must operate with a permit to work, and carry out safety education and training. Before the start of special operations, it needs to ensure the personal safety of special operators. It is suggested to avoid safety management accidents caused by insufficient safety management and inadequate management work, which affect the progress of construction and damage the quality and economic benefits of construction projects [4].

For construction management, enterprises should clarify the different safety management programs for different stages of construction in the pre-construction survey stage. For example, before the construction project starts, the relevant departments of the enterprise should prepare the safety plan for the whole project, evaluate the safety construction situation, and prepare the emergency plan for the whole construction project. In the construction stage, for different buildings and their construction technology requirements, the safety management plan should be adjusted appropriately, and safety management measures should be adjusted. These measures could ensure that under the changing construction situation, the safety production can run continuously, the progress of the construction and the personal safety of the construction personnel on site. After the construction is finished, the safety acceptance of the construction project is carried out following the regulations, the project is investigated for the existence of safety loopholes, and the safety quality of the construction is ensured through these ways. In addition, safety management should also focus on the management, and managers should strictly control the quality of construction materials to ensure that the safety of construction meets the standards. All the construction equipment and safety gear should also be strictly managed to ensure the equipment's normal operation and the operator's personal safety when carrying out construction work, to implement personal protection safety [5].

In the industry environment, enterprises and individuals need to be compliant in bidding and should not disrupt the industry order by bidding maliciously for profit. The government should develop a strict approval process to ensure fair bidding and qualified construction companies, to prevent illegal subcontracting and malicious bidding. In addition, the construction industry also needs to be rectified, some non-compliant behavior in the industry should be stopped, and the quality of construction should be strictly controlled to prevent non-compliant behavior from eventually becoming a safety hazard that causes safety accidents. Safety management and industry should influence each other, rather than let safety management work a conform to the industry's status quo, only to ensure the proper development of the industry, and to make safety management an active role.

3. Construction safety technologies

3.1. Construction safety technologies

Construction safety technology and the corresponding protective measures need to improve the final quality of building construction, ensure that construction personnel can have a relatively safe working environment. Construction safety technology involves many areas that can link all stages and parts of the construction project. For the safe production of building construction, safety

technology must be guaranteed, otherwise, it could make the construction project difficult or even paralyze the whole project. On the other hand, safety technology involves construction equipment, personnel management, professional technology, construction raw materials. Therefore, ensuring the smooth implementation of construction safety technology in the process of construction can enhance the economic benefits, safety and security, and project quality to the greatest extent [6].

Construction safety technology can be roughly divided into three categories. The first is deep pit support construction safety technology, foundation construction is the pillar of the whole construction project, and deep pit support is an important link in the foundation construction. The implementation of this technology is related to the safety of the construction personnel on site and the stability of the surrounding building environment, which can not only ensure the quality and safety of the underground structure but also guarantee the stability of the construction personnel and the whole project. Specifically, deep foundation support technology is mainly used to strengthen the soil under the building by various technical means to ensure that the soil could not collapse due to the construction of the building and cause accidents. Common techniques include pile column support, such as row pile support, sheet pile support piles, and deep mixing pile construction techniques. The builders use these techniques to establish a good soil structure, providing better waterproofing and load-bearing capacity. Retaining and diaphragm walls are also constructed to make the building foundation better suited to the various requirements of building construction. In addition, anchoring and nail support techniques are used to secure the soil structure to prevent collapse. All these techniques are to strengthen the main body of the foundation construction, provide safety technical support for the construction safety of the foundation construction, ensure the safety quality of the foundation construction, and make a solid and stable cornerstone for the construction of the main building [7].

The second is foundation construction safety technology. As an important part of building construction, the foundation is the main core of the whole building construction. A good foundation is an important guarantee for the stability and safety of the building. In the process of building construction, various factors lead to various safety problems in the foundation, and the foundation construction safety technology exists to solve such problems. The specific construction techniques include replacement, pre-pressure, chemical reinforcement, joint settlement setting, etc. Among them, the replacement method is to improve the bearing capacity of the foundation by backfilling the compacted soil into the foundation to achieve the rectification of a bad foundation; the pre-pressure method is to improve the stability of the foundation by compacting the material to be filled before treatment to improve the performance of the material, and this technology has been widely used in the construction of buildings. The chemical reinforcement method is to fill the foundation materials with special chemical substances to improve the foundation performance and achieve a good foundation. In addition, if poor foundations are encountered during construction, setting settlement joints can be used to deal with them, but this method must consider the influence of soil quality and the surrounding environment and cannot be constructed blindly [8].

The third is the safety technology of water supply and drainage construction. Water supply and drainage construction are indispensable in construction because it involves the pipeline setting of the whole building. More attention must be paid to safety, especially in protecting the pipe-jacking position of water supply and drainage construction. Before the drainage construction begins, drawings must be drawn first to confirm that the pipeline settings meet the construction standards and would not affect other construction processes, and to ensure that the site planning is reasonable and set up support reinforcement. During the construction process, the construction situation should also be checked regularly to ensure that the construction situation on site is consistent with the design plan. In addition, the pipe diameter and quality should also be strictly accounted for, to ensure the safety nature of pipe jacking while enabling the construction project's economic benefits [9].

3.2. The Combined Application of Innovative Technologies

With the exploration of technology and the market's needs, more and more innovative technologies are implemented and applied to building construction, bringing new construction methods and providing new opportunities for the development of safety technology. For example, the emergence of assembled buildings, which are more environmentally friendly than traditional construction methods and can save labor and economic costs to a greater extent in construction, are widely used in production and construction. However, there are also new safety production problems in assembled buildings because of the difference in their construction methods, which require many technicians to work on-site, and the prefabricated parts used in construction are different from traditional construction materials, and the management methods have to be changed. Such a complicated situation can promote construction enterprises to take the initiative to improve safety management programs, implement safety education and training, and promote the development of safety production management in the construction industry.

In addition, the emerging BIM technology can be combined with safety management. BIM technology is usually applied to the model building and budgeting of building construction, mainly to visualize the architectural design, and visualization technology can also be used in safety management. Through the installation of detection equipment at the construction site, the real-time data could be transmitted to the mobile control device of safety management personnel through the cloud to realize remote monitoring and assistance management of safety management personnel, and the hidden dangers of safety products can be found promptly according to the changes in the site data for inspection and maintenance, which largely improves the safety quality of building construction. And after the completion of the construction project, BIM technology could be used to complete the overall building safety quality inspection and acceptance to ensure the safety and stability of the building [10].

4. Conclusion

Building construction safety is a common theme, and all enterprises and individuals are trying to achieve safety and avoid serious consequences of accidental injuries. But the problem of building construction safety is not caused by a single factor, which involves many complex factors, and often several factors interact with each other to cause accidents. Thus, the safety problem can never be completely solved. Although China's construction industry currently relevant construction regulations still need to be improved, with the development of science and technology, the industry's own ability to improve, and the government's more attention to the construction industry, these problems have professionals to put forward relevant solutions to try to solve.

In general, the process of construction involves many aspects of safety, and has been becoming more complex with the increase in construction requirements, safety production management and safety construction technology to meet the requirements of construction safety. In the process of construction, safety management is an important management tool to maintain the construction site, and safety construction technology is an important guarantee for the safety and quality of building construction projects. Management tools and construction technology affect each other. There is a perfect safety management system to ensure the effective implementation of safety construction technology, and the use of safety construction technology is the best proof that safety management work is carried out effectively. Only the implementation of the responsibility system for safety production, conduct safety education and training for employees, perfect safety management system, and reasonable use of safety construction technology can ensure the effective implementation of construction projects and the safety quality of construction projects. Therefore, enterprises in the construction and development process should focus on the construction of safety management and the reasonable application of safety technology. The interplay of the two is the important content of the construction project and an important advantage of enterprises in the industry competitors.

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