Safety risk analysis of high-rise steel structure building construction

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Abstract. At present, in the construction of high-rise steel structures, many construction companies have inaccurate grasp of the key technologies of steel structure construction, and in specific construction, they still follow past construction experience, resulting in the lack of guarantee for the quality of steel structure construction. In the construction of steel structures, there is a great correlation between various sub items, processes, and before processes. In addition, there is a close relationship between the progress, quality, cost and safety of the project. If there is a problem in any node or link, it will have a chain reaction, affect the realization of other goals and expand losses. This paper first expounds the characteristics of building steel structure, then analyzes the safety risks of high-rise steel structure construction, and finally puts forward the safety management strategies of high-rise steel structure construction, including innovating steel bar welding technology, risk control of environmental factors, strengthening on-site supervision of construction projects and increasing the application of BIM technology.

Keywords: Safety risk, high-rise, steel structure, building construction.

1. Introduction

As a kind of project with large construction scale, high technical level, great environmental impact and large quantities, building engineering must strengthen management to minimize the possibility of danger in the process of safety supervision, so as to ensure the construction and use quality of the building and improve the overall safety factor of the project. Steel structures are widely used in high-rise buildings because of their light weight, high strength and good seismic performance [1]. However, as far as the current high-rise steel structure construction is concerned, many construction enterprises are not sure about the key technology of steel structure construction, and they still follow the previous construction experience in the specific construction, so that the quality of steel structure construction can not be guaranteed. In the process of project construction, construction units need to use engineering construction theory and technical means to carry out orderly planning management, organization management, supervision management, coordination management and control management.

2. Characteristics of building steel structure

Steel structure engineering takes steel structure as a building structure, which is mainly composed of steel beams, steel columns, steel trusses and other components made of steel and steel plates. The components or parts are usually connected by welds, bolts or rivets. The fabrication and installation process of steel structure requires higher dimensions of steel structure members. Only by accurate measurement and rigorous and accurate calculation can the dimensions of the members be ensured to be correct, and then the steel can be accurately cut to ensure that the fabrication of the members meets the design requirements. Once the blanking deviation is caused by calculation error, the irregular deformation of steel members will occur, which will affect the installation of steel members and the whole steel structure project [2-3].

According to the current situation of building construction, if you choose to use general materials in the construction, it is bound to break when the materials are subjected to pressure, but the steel structure materials can effectively avoid this problem in the application process. In steel structure engineering, embedded rigid column foot bolts are generally used to connect the column foot with

reinforced concrete foundation. Column foot bolt is a temporary fixing measure to control the plane size and elevation when the first steel column is installed in place. Therefore, when the column foot bolts are embedded, the foundation axis and elevation datum point should be strictly controlled, and the deviation of the positioning axis should be controlled within ±2mm, and the elevation deviation should be controlled within ±5mm [4-5]. Use theodolite to track and check the verticality and inclination of the column, then adjust the accurate position of the component to ensure that all bolt holes are aligned, and put in high-strength bolts for temporary fixation.

3. Safety risk analysis of high-rise steel structure building construction

Engineering risk refers to the difference between actual results and expected goals and the probability of occurrence in the process of project decision-making and implementation. Difference refers to the uncertainty of personal injury, property loss or other economic losses and the uncertainty of income [6]. Risk includes three parts: risk factors, risk accidents and risk losses. The three influence each other.Generally speaking, the project has the characteristics of long period, large scale and wide scope, and there are a lot of risks in all stages of the project. Not only are the types of risk factors diverse, but also the types of risks are diverse in the whole construction process. The internal relationship between a large number of risk factors is still very complex and cross-influenced, which makes the risks show multi-level characteristics [7].

Risk exists not only in a certain construction stage, but in the whole life cycle of construction. At each stage, there are risk factors such as personnel, machinery and equipment, management and environment, which interact and influence each other, and the risks in one stage will affect the next. The risk factors affecting the construction safety of this project can be divided into four aspects: human factors, mechanical and material factors, management factors and environmental factors, which can be represented by the biting fish diagram, as shown in Figure 1.

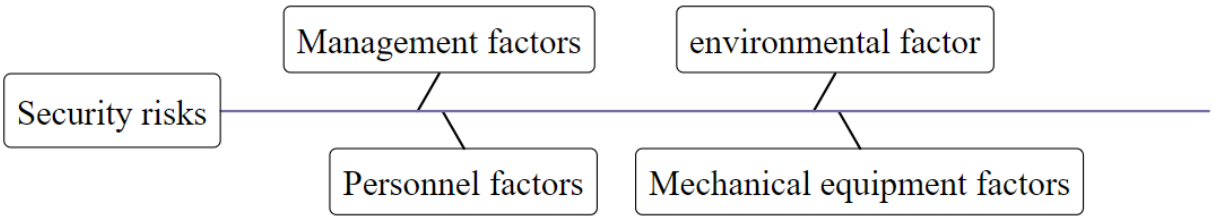


Figure 1 Safety risk factors of high-rise steel structure building construction

The construction of material machinery depends on people, and the risk factors of material machinery directly restrict the operation and use of people. At the same time, the situation of material machinery is closely related to the level of safety management. If the material machinery is in an unsafe state, it will affect the construction environment, which will have an impact on environmental risk factors.

Environmental factors include natural environment, living environment and construction environment, and environmental factors will have an impact on materials, machinery and human factors. For example, when encountering bad weather such as strong wind, rain and snow, it will affect the welding operation of steel structure. The welding operation in strong wind will make the sparks generated by welding splash, which will easily lead to fire. The welding operation in rainy and snowy weather will easily lead to electricity accidents. It can be seen that environmental factors will not only bring loads to mechanical and material factors, but also affect personnel factors, affecting people's working conditions and psychological conditions [8-9].

From the perspective of engineering insurance, because the risk may be stopped due to the intervention of some factors in the process of risk performance, extremely serious risks cannot be formed at this time, so the evaluation standard for judging whether the risk belongs to extremely serious risks is impact, that is, as the final result of risk performance, engineering insurance needs to set up extremely serious risk evaluation indicators and standards first. It is worth noting that to

evaluate whether the risk is a serious hazard risk, we must focus on the impact, that is, the impact represents whether the risk plot is serious, and we can evaluate it according to the impact items.

The actual construction quality of construction projects has a direct impact on the professional level of supervisors. From the perspective of professional knowledge, the professional technology of supervision work involves not only project management and on-site supervision, but also the corresponding knowledge of law and architecture to a certain extent, so the professional level of staff is required to be higher. At the same time, due to the need to manage the construction site, engineering equipment, design scheme and other details, it is necessary for supervisors to implement unified management standards, and the complexity of the construction site has also increased the difficulty of unified management [10].

In the construction of steel structure, there is a great correlation between each sub-item, process and before process. In addition, there is a close relationship between the progress, quality, cost and safety of the project. If there is a problem in any node or link, it will have a chain reaction, affect the realization of other goals and expand losses. Risk management should pay attention to the basic situation of investigation and analysis, understand the understanding of industry experts on the scope and law of risk, as well as the methods and working procedures for risk treatment, and systematize, informatize and knowledgeable them to provide the decision-making basis for subsequent projects.

4. Safety management strategy of high-rise steel structure building construction

2.1. Welding technology of manufacturer's steel bar

There are many floors in high-rise buildings. In concrete construction, the steel structure will bear more weight with the framing of the floors. In order to ensure the stability of the steel structure, scientific welding technology must be used. In the welding of steel structure, it is necessary to strictly follow the design requirements, clarify the welding sequence, and select reasonable welding materials and welding technology, so as to improve the stability of steel structure and ensure that steel structure can meet the needs of high-rise building construction.

Steel welding technology in steel structure construction plays an important role in welding auxiliary materials, and its welding technology and materials determine the welding quality. Therefore, the construction personnel must choose the best welding method according to the specific situation, and at the same time study how to further improve the welding quality, so as to lay a solid foundation for the later installation of steel bars. According to the code for construction and acceptance of steel structures, all aspects of installation links and welding results need to be strictly tested, including bolts and hole spacing, and should be dealt with in time if problems are found.

2.2. Risk control of environmental factors

Environmental factors have little influence, and among them, the most important thing is to control the construction environment. First, strengthen the risk control of aerial work environment. Personnel involved in the management of aerial work and front-line operations must pass the physical examination before taking up their posts. At the same time, we should always pay attention to whether the distance between oxygen and acetylene cylinder meets the requirements of safe distance and the removal of flammable and explosive substances on site. Ensure the normal operation of lighting equipment at night. It is necessary to strengthen the risk control of the surrounding environment of the operators.

2.3. Strengthen the supervision of construction site

The project construction process is complex, large-scale, and long-term. There are many uncertain factors in the construction, and the risk is greater than other projects. The task of risk management is to reduce the certainty of casualties, property economic losses and other losses, or to transfer risks.

Engineering risk management process is a systematic, complete and cyclic process, which mainly includes five steps: risk identification, risk estimation, risk evaluation, risk response and risk monitoring, as shown in Figure 2:

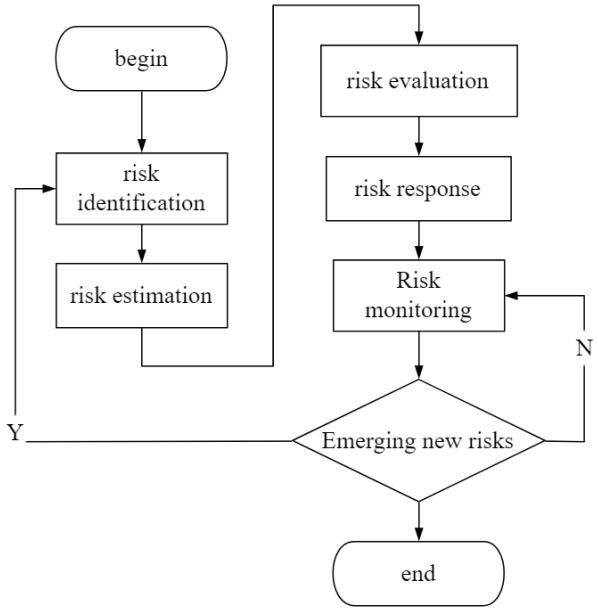


Figure 2 Engineering risk management process

The safety supervision system mainly manages the behavior of the construction site, and improves the overall construction quality of the project through unified management norms. In the process of implementing the regulations, responsibilities should be clearly divided according to different construction links; Secondly, carry out engineering construction according to the technical requirements of architectural engineering design scheme. In the process of project implementation, due to the actual engineering quantity and technical requirements of construction projects, some large-scale mechanical equipment needs to be used, and the acceptance, adjustment and operation of equipment need to be supervised by management personnel. Improve the safety awareness of the supervision staff, conduct regular safety lectures, help the staff understand the safety skills needed in the operation of construction technology and construction equipment, and train the safety emergency and sudden accident handling methods, so that the supervision staff can timely reflect the accident situation and make correct judgments, thus avoiding property losses and casualties.

2.4. Increase the application of BIM technology

Engineering insurance not only plays a good role in risk management of large-scale projects, but also plays a role in engineering science and technology innovation, such as introducing big data technology and BIM technology into risk management. In the construction of high-rise steel structure buildings, construction enterprises can establish a visual model of high-rise buildings with the help of BIM technology, analyze the construction of high-rise steel structures through software systems, and determine the relevant parameters of steel structure construction, so as to facilitate construction enterprises to formulate scientific construction plans.

Firstly, a complete engineering model can be obtained by BIM technology. After the project breaks out, the model can be compared, and the project loss after the risk can be accurately judged, and the risk can be classified accordingly. Secondly, the model can be used to judge whether there are potential safety hazards in the project at present, and if there are, it can be eliminated in time, which shows that this technology can play a role in preventing risks.

5. Conclusions

Steel structure engineering takes steel structure as a building structure, which is mainly composed of steel beams, steel columns, steel trusses and other components made of steel and steel plates. The components or parts are usually connected by welds, bolts or rivets. Risk exists not only in a certain construction stage, but in the whole life cycle of construction. At each stage, there are risk factors such as personnel, machinery and equipment, management and environment, which interact and influence each other, and the risks in one stage will affect the next. In the construction of high-rise steel structure building, managers should reasonably adopt insurance mode and innovative technology based on the types of project risks, so as to prevent and eliminate risks.

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