Analysis and Management Control of Highway Engineering Construction Safety Accidents Based on Dynamic Identification of Hazard Sources

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Abstract: In recent years, my country's highway construction has developed rapidly. It has gradually expanded from the previous development in various provinces to highway construction in various regions, which has greatly improved my country's transportation network and brought us a more convenient way of life. However, while we see the achievements, we cannot ignore the safety issues of highway engineering. In order to ensure the quality and safety of the construction site, it is necessary to formulate effective management and control measures. This paper starts with the low quality of construction personnel and the lack of safety management system, analyzes the causes of safety accidents in highway engineering construction, and introduces the identification of dangerous sources in highway bridge construction. Finally, it analyzes the management and control countermeasures based on safety accidents in highway construction from two aspects: establishing safety production management system, increasing the input of safety production factors, perfecting safety production management institutions and implementing the responsibility system. It is expected that under the background of the new era, both construction enterprises and on-site managers should increase the research on safety accidents, strengthen the control intensity of on-site safety management, and focus on optimizing the overall safety management level, so as to ensure the quality and safety of expressway construction projects.

1. Introduction

With the progress and development of social economy, China's transportation industry has been promoted rapidly. Especially in recent years, the country has made great efforts to develop infrastructure construction to stimulate domestic demand. Therefore, highway construction has been vigorously promoted. As the safety management of expressway construction project is comprehensive and complex, the site management personnel should start from the whole construction process and put forward effective management modes according to the construction requirements of different links. Only in this way can we ensure that the site construction work can be implemented orderly [1]. Because the national economy needs developed highway transportation to carry it, which requires that China's highway construction must have a high-quality and high standard construction environment, because it is related to the national security and stability. However, more and more highway construction safety accidents have sounded an alarm to the construction units. Therefore, the quality and safety of highway construction have attracted much attention.

At present, China's highway engineering construction safety management and accident prevention generally belong to "experience control type" and "process control type", and a relatively complete accident prevention system has not yet been formed, so it is impossible to effectively suppress the accident signs and prevent the occurrence of accidents in advance. According to the current situation of expressway construction, although the increase in the number of construction projects meets the needs of urban construction and residents' travel, under the background of the gradual improvement of project requirements, it also increases the probability of

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safety accidents in project construction, such as collapse, tipping and falling of girder supports. These phenomena will not only affect the construction progress of the project, but also threaten the safety of life and property of on-site staff. In fact, the management core of the health and safety management system as a modern safety production management mode is the hazard source, not the accident. Accidents are the possible consequences after the occurrence of hazard sources, and the management of accidents can only be post event management. There must be reasons for any accident, including unsafe behavior of people, unsafe state of objects, management defects, etc. [2]. At present, China is speeding up the construction of infrastructure, the number of highway and bridge projects is increasing, and the importance of safety management is becoming increasingly apparent. Enterprises must comprehensively analyze potential construction safety hazards, effectively ensure the safety of the construction site, and form a normalized safety management mechanism.

2. Cause Analysis of Safety Accidents in Highway Engineering Construction

2.1. Poor quality of construction workers

Migrant workers have poor awareness of safety construction prevention. Due to the lack of safety awareness, they will have some improper operations. Construction workers ignore necessary safety knowledge training during construction, and do not master safety production knowledge proficiently, resulting in the occurrence of safety accidents. . The cultural level of famous agricultural workers is generally low. Although they are also participating in safety training, their understanding of safety knowledge and rules and regulations is not deep enough, their self-protection ability is very low, and they are exposed to serious safety risks during construction. At present, many construction units have realized the importance of safety management and started to promote the concept of safety management in practice, but the overall safety awareness is still weak and does not meet the expected construction requirements [3]. At present, with a large number of graduates flooding into the market, construction enterprises should pay attention to their work quality and professional skills while hiring outstanding talents. Although the professional knowledge learned by colleges and universities in the past is advanced, it is different from the actual operation. Therefore, enterprises can organize them to participate in the training activities provided by experienced technicians to ensure that they can integrate the knowledge learned in textbooks with the actual work.

2.2. Lack of safety management system

Generally, the safety management system formulated by the project department is not perfect. It is just an example to deal with the superior inspection, which is fundamentally inconsistent with the actual situation on site and has no practical guiding significance. Many construction enterprises are seriously lacking in safety system management, so they do not have the ability to deal with emergencies in case of emergencies. There is an extreme lack of safety measures, and the safety responsibility is not specific to the person, which leads to the lack of supervision in the implementation and inspection of safety management, and the work is extremely irresponsible. Over time, the safety system is only a face project. In order to further obtain benefits and reduce costs, the construction department does not specially set up safety management personnel, but personnel from other positions. These temporary safety personnel can not assume the responsibility of safety management and supervision, lack corresponding safety management ability, and have no practical value in the face of emergencies [4]. In addition, although some construction companies will provide corresponding construction guidance, they are only used in bidding and have not been implemented in the on-site construction management work, which will not only increase the loopholes in safety management, but also cause uncontrollable safety accidents.

3. Identification of Dangerous Sources in Highway and Bridge Construction

The general principles of hazard source control mainly include: (1) based on eliminating and

reducing risks, building system security, and implementing personal protection; (2) focusing on prevention, combining prevention and control, and a linkage mechanism between plans and emergency measures; (3) dynamic tracking, Focus on control and respond in a timely manner. For unbearable dangers, operations should be prohibited, major dangers should be rectified immediately; moderate dangers should be rectified within a time limit. The construction environment of highways and bridges is complex and changeable, there are many safety risk factors on site, and some enterprises have weak safety awareness, which is easy to bury huge safety hazards [5]. There are four construction hazards: bridge pile foundation, high pier, capping beam construction, beam prefabrication and erection, and cast-in-place box girder. Drilling method and manual digging method are commonly used in bridge pile foundation construction. The hazards of bored pile construction mainly include: hammer falling from a height, electric shock injury, lifting injury, mechanical injury, object impact, ground subsidence around the casing, explosion of oxygen cylinder and acetylene cylinder, etc. See Figure 1 risk identification flow chart.

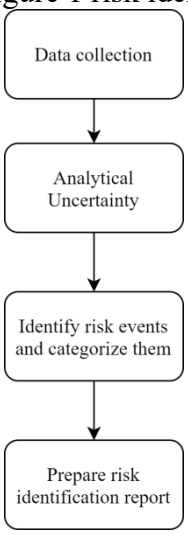

Figure 1 Risk identification flow chart.

The construction of pier columns and bent caps of highway bridges is mostly carried out at high altitude. Common hazard sources include: falling from high altitude caused by insufficient strength of the working platform or operators' failure to wear safety belts, broken lifting wire ropes, falling of lifting objects caused by binding not in accordance with the specifications, collapse caused by weak anchoring of safety ladders, burns caused by improper welding protection during processing of reinforcement cages, etc. Beam prefabrication and hoisting is the main method of highway bridge construction in China at present. Potential hazards mainly include: formwork hoisting, reinforcement hoisting, beam out of pit, object strike and mechanical injury during installation, mechanical injury to personnel caused by high-strength prestressed steel strand tensioning, electric shock, falling from height, and heat stroke caused by high-temperature operation [6]. The construction of cast-in-place box girder is commonly used with cast-in-situ method and hanging basket construction method. Among them, the main danger sources of cast-in-situ box girder construction with full support are: the collapse of the support caused by insufficient strength of the support foundation or the wrong construction sequence, and failure to set up safety protection as required. High-altitude falls caused by nets and railings, unfastened seat belts, and work platforms that are not fully paved with slabs, etc., object strikes and mechanical injuries caused by the lifting of formwork, steel bars, steel strands, etc., various types of electric shock accidents, etc. Common hazards in the construction of cast-in-place box girder with hanging baskets include: falling from a height, mechanical injury, electric shock injury, lifting injury, fire, extreme weather disasters, etc. See Table 1 for the identification list of common hazard sources.

Table 1 Identification list of common hazards.

Hazard Type	Specific hazards
Natural environment hazards	Earthquake disaster
	Lightning fire
	Meteorological disaster
	Geological disaster
Manage environmental hazards	Equipment safety license acceptance, operator safety Certificate employment defect
	Defects in the establishment of safety agencies and staffing of safety management personnel
	Defects in safety education for construction workers
	Security scheme setting flaws
Surrounding environment hazards	Surrounding Hazards Overhead Hazards
	underground pipeline hazards
	Adjacent to structural hazards

4. Analysis of management and control countermeasures based on highway construction safety accidents

4.1. Establish a safety production management system and increase the input of safety production factors

The safety production management system is the code of conduct for all parties involved in the project. Therefore, construction companies must establish safety production rules and regulations, and use the system to regulate and restrain construction personnel to ensure that construction safety management has laws and regulations to follow, and clearly defines personnel at all levels. When encountering illegal construction, forced construction, or hidden dangers in construction, it should be reported in time, and the relevant personnel should be ordered to make corrections immediately [7]. It is necessary to strengthen the stacking management of raw materials. Since it is difficult to adopt a closed mode at the construction site of highway engineering, raw materials such as cement concrete are easily affected by the external environment. As well as related facilities, to the greatest extent possible to prevent changes in the properties of raw materials caused by environmental factors. Establish and improve the hazard identification ledger, formulate feasible safety measures and emergency plans, conduct regular safety drills, make drill records, and make timely corrections for problems found during the drills. In view of the hazards and potential safety hazards existing in the project construction, the construction unit should increase the input of safety production factors to ensure the full amount of safety production factors, so as to avoid property losses and casualties caused by safety accidents [8].

4.2. Improve the safety production management organization and implement the responsibility system

The core of safety management is "people", and the construction unit shall firmly establish the management concept of "safety first". Highway engineering is a comprehensive and highly complex project, which involves a variety of raw materials in the construction process. In addition to the basic cement, gravel, asphalt and other materials, it also includes other different types of raw materials. In order to ensure the smooth progress of raw material test and inspection, it is necessary to ensure that the test and inspection team has high professional ability and comprehensive quality [9]. Carry out targeted safety education and training, so that the construction personnel can master the safety operation procedures, learn to identify the hidden dangers of safety production, effectively respond to emergencies, and understand that safety production is the best protection. The safety management agency should improve relevant safety measures and establish a safety precaution mechanism according to the actual situation of on-site construction, and when a safety accident occurs, it should promptly investigate the cause of the safety accident. Safety responsibilities should be clarified, responsible for the safety of all construction workers, and

practically implement the construction guidelines of safety first. The management of machinery and equipment requires the project department to make arrangements, to deploy and maintain the machinery and equipment to be used in a timely manner, and to train operators to improve their professional abilities, and do not conduct blind command work [10]. Therefore, we need to establish and improve a dynamic safety management system based on dynamic identification of hazard sources, realize real-time tracking, detection, evaluation, monitoring and early warning, and comprehensively and meticulously analyze the risk factors and control points in construction to the maximum extent.

5. Conclusions

At this stage, the construction industry has become one of the pillar enterprises in China, but the safety management problem in the construction process has always been the management difficulty of the enterprise, and the occurrence of production safety accidents is not caused by a single factor, but by a combination of various management factors. Construction safety is an eternal theme in the process of highway construction. Safety management is an important part of highway construction enterprise management, an important guarantee to realize highway construction safety production, and also a complex system engineering. Enterprises must fully realize the importance of highway and bridge construction safety, and carry out safety management throughout the whole construction process, so as to obtain maximum social and economic benefits. Therefore, under the background of the new era, both construction enterprises and on-site managers should increase the research on safety accidents, and put forward targeted solutions based on their own work experience. At the same time, it is necessary to strengthen the control intensity of on-site safety management and focus on optimizing the overall safety management level, so as to ensure the quality and safety of expressway construction projects.

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