Study on the Safety Evaluation of Prefabricated Building Construction

Chao Fan

School of Chengdu Polytechnic, Chengdu, Sichuan, China

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Abstract: Prefabricated buildings are used to produce prefabricated components in the factory, which are assembled, connected and partially cast-in-situ at the construction site. Compared with traditional buildings, prefabricated buildings save energy and resources, make the construction process more environmentally friendly, and increase the technological content of the construction industry. Prefabricated buildings are at the initial stage of development. To make the prefabricated buildings develop continuously, the problem of construction safety management must be solved. The establishment of a prefabricated building construction safety evaluation system is only part of the safety management work. Only by establishing a scientific and accurate prefabricated building construction safety evaluation system can we make an accurate judgment on the safety of prefabricated building construction. However, the current research on the safety evaluation of prefabricated building construction in China is still in its infancy. There are problems such as incomplete evaluation index system and scientific evaluation methods. Therefore, in-depth research on safety evaluation of prefabricated building construction is needed. Set of scientific and accurate evaluation systems and methods.

1. Introduction

The construction industry is a high-accident industry, and construction safety issues cannot be ignored. Due to the high-risk nature of the construction industry and the large number of employees, accidents such as collapses, object strikes, electric shocks, and falls from heights occur from time to time. Projects with complex shapes and avant-garde construction have increased the difficulty of building construction safety. China's construction workers are mainly migrant workers, and the flow of people is fast. They have not been trained in a professional system, and their awareness of safety and prevention is weak, which increases building construction safety risks. In addition, in the fiercely competitive environment of the construction market, some construction units are paying more and more attention to costs and schedules, ignoring safety protection and safety management work, and reducing construction safety costs, which is another cause of frequent safety accident in the construction industry. Safety accidents have a huge impact on economic losses, and investment costs increase, which not only affects the profit and development of the construction industry, but also consumes a lot of resources. There were a large number of casualties in the accident, which affected the stability of society. Therefore, the management and supervision of construction safety have drawn great attention from all walks of life. The main bearer of the consequences of a safety accident is the construction enterprise. Once a safety accident occurs, the construction enterprise will face economic compensation, which will affect the image and development of the enterprise. Therefore, construction safety management should be paid more attention by enterprises.

2. Construction Characteristics of Prefabricated Buildings and Identification of Their Hazard Sources

Dangerous sources are the direct cause of various types of accidents. There is no generally accepted definition in the scientific research community. Dangerous sources basically mean accident dependent variables that can cause injuries, diseases, and property damage. The accident dependent variable can be a certain state, a certain behavior, a root cause, or a combination thereof. The danger source of the construction project is the hidden danger and unsafe factors that are likely

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to cause accidents when the project is constructed. These hidden dangers and unsafe factors include: the unsafe state of machinery and equipment, the unsafe behavior and awareness of managers and construction personnel, unsafe factors such as climate and environment, and lack of management work.

The unsafe state of people's unsafe behaviors are the most important factor leading to construction safety accidents. According to the accidental energy release theory, the dangerous sources of accident items can be divided into the first type of dangerous sources and the second type of dangerous sources. The first category of hazards determines the severity of the consequences of an accident, and the second category of hazards determines the likelihood of an accident. The existence of the first type of dangerous source is a prerequisite for the emergence of the second type of dangerous source, and the appearance of the second type of dangerous source is a necessary condition for the accident caused by the first type of dangerous source. The first category of dangerous sources refers to the energy or dangerous substances that may be released accidentally, including the unsafe state of substances and unsafe environmental factors. According to the possible location of the dangerous source, the construction stage in which it is located, the consequences of the resulting safety accident, and the area where the construction project is located, the first type of dangerous source is divided into three categories: existential, potential and situational sources : Existing hazards refer to unsafe behaviors and unsafe states that inevitably exist in the construction process due to social conditions, management levels, construction techniques and the environment. Potential sources of danger refer to unsafe factors that may cause personal injury, death, and property damage with the gradual accumulation of hazards over time and changes in the working environment. Each potential danger source has its own differences, and a corresponding solution should be formulated according to the individual to resolve its dangerous state. Situational hazards refer to unsafe environmental factors that occur when rare or extraordinary events occur and individuals cannot predict and control them. Such as earthquakes, wars, etc. belong to such sources of danger.

The first type of dangerous source mainly appears in the following forms in the construction project: The devices and equipment that generate and supply energy, such as temporary cables and air compression equipment. Installations, equipment, and places that make the human body or objects have a higher potential energy, such as high-rise equipment such as elevators and suspension towers. People, objects or places with energy, such as various types of machinery and equipment, and excavated foundation pits. Hazardous substances with chemical energy are divided into two categories: combustible and explosive hazardous substances and toxic and harmful hazardous substances. The external energy applied to the construction project by the natural environment, such as earthquakes and high temperatures.

The second category of dangerous sources mainly includes human unsafe behaviors and management defects. They are the direct causes of accidents and mainly include the following 4 types: Unsafe state of objects: refers to unsafe objects that enable accidents Conditions or physical conditions, that is, the phenomenon that mechanical equipment, devices, components, etc. cannot perform their intended functions due to their underground performance. “Material” includes machinery, equipment, devices, tools, materials, and also houses, temporary buildings, etc. Unsafe behavior of human: It means that the result of human behavior deviates from the required standard, that is, the phenomenon of failing to complete the prescribed function, that is, the violation of safety rules by the construction personnel, which is an act that may or may occur in an accident. ③ Environmental impact: The environment in which people and objects are located during construction operations, including problems with humidity, noise, disturbance, lighting, temperature, or ventilation. Poor physical environment will cause human error and adversely affect mechanical equipment. The physical environment can be divided into natural environment and production environment. For example, the equipment on the construction site is disorderly placed, construction materials are randomly stacked, and production and living power are set up without permission. This will not only affect the convenience of normal production and life, but also increase the anxiety of the people in the environment, thereby increasing the probability of accidents; summer

The hot heat of the construction personnel caused severe physical overdrafts, which reduced the reaction speed and difficulty in focusing; the severe cold in winter would cause the construction personnel's body to be stiff and slow to move; temperature, humidity, and sandy weather will affect the operation status of the equipment.

3. Basis and Principles for Selecting Safety Evaluation Indicators for Prefabricated Buildings

First of all, unified methods and standards should be used when modeling, and the evaluation results of construction safety can be compared with each other, showing the comparability of the evaluation results. Then, the conclusion is drawn from the comparison results, which provides a theoretical basis and decision basis for the optimization of prefabricated building construction in the future. The purpose of establishing an index system for construction safety evaluation of prefabricated buildings is to use the collected data and data on prefabricated construction safety to evaluate the safety of prefabricated construction projects effectively and reasonably. The accuracy and suitability of the design of the index system has a direct impact on the accuracy of the results obtained when evaluating the safety of prefabricated buildings.

The selection of prefabricated building construction safety evaluation indicators should follow the following principles: The structure of the index system and the evaluation criteria must be based on the characteristics of prefabricated building construction. The structural analysis of the appraisal system should be based on the essence is analyzed and divided, so that the indicators are objective and the evaluation results are reasonable. The principle of objectivity requires scientific basis for the selection of indicators, data processing, and calculations. Comprehensiveness Safety evaluation is a comprehensive multi-factor comprehensive analysis and evaluation. Therefore, the selection of indicators must be universal and able to represent certain types of factors. When establishing an evaluation index system, the coverage of the index should be broad enough to enable further cluster analysis. The index evaluation system constructed should be able to reflect systematically and fully the overall level of project construction safety. Systematic principles in addition to meeting the comprehensive requirements when selecting indicators, the relationships between indicators and the relationships between various levels should also be considered. The establishment of the indicator system should be systematic, and the indicators should be screened according to system characteristics. The comprehensiveness of the selection of the prominent principle indicators should be based on the main contradictions of the entire system in terms of safety, and select indicators around human, material, machine, environment, management and other factors. The indicators should not miss the internal factors that may cause accidents. Only when typical and outstanding indicators are found can it have practical significance for its safety evaluation. The selection should start from the overall system and focus on the outstanding points in various aspects. Representative evaluation factors are indispensable.

4. Commonly Used Evaluation Indicators in Safety Evaluation

The current safety evaluation indicators are sorted, and the calculation basis can be divided into three types: risk indicators, accident indicators and hidden danger indicators. Risk indicators Risk indicators are generally based on the consequences of accidents and their probability of occurrence. The consequences of accidents are divided into two aspects: degree and cost, and direct and indirect losses. The outcome probability indicators include the number of people in a dangerous state, the time in a dangerous state, and the possibility of an accident. The accident risk and the probability of occurrence are used to estimate the risk value, and the result is more accurate. The problem is that it is not possible to find all the risks. The reason is that only the past or predictable accidents can be used for risk index analysis. In addition, when the data is not complete, the estimated risk value will have considerable uncertainty. Accident indicators at present in China and many countries, accident indicators are often used as an indicator of safety assessment. The evaluation basis of accident indicators is mainly the situation of accidents during construction for a period of time. Accident indicators are classified according to the nature of the factors. There are two types of accident

indicators, absolute accident indicators and relative accident indicators, which usually include the accident rate, number, and the size of the accident loss. Hidden danger indicator Hidden danger indicator is also a process indicator. It takes the system as a whole and conducts a comprehensive and comprehensive safety evaluation of the personnel and equipment. Hidden danger indicators do not take the impact of an accident on the system as a reference, but determine whether the system meets the specified requirements and achievable standards from the constituent factors of the indicator system and the relationship between the factors, and classifies the system security status based on this. Hidden danger indicators can be used to distinguish all factors that affect the safety of the evaluation objects, and the potential dangers of the project can be completely found out.

5. Conclusion

Prefabricated building construction safety is the basic premise for the promotion of prefabricated building in China. Only by solving the safety problem can prefabricated building be developed. This article analyzes the factors influencing the safety of prefabricated building construction based on the existing relevant management rules and regulations in other countries, regions and parts of China, and analyzes the influencing factors scientifically using rough set theory. Ground screening reduces the difficulty of safety evaluation of prefabricated building construction and reduces the calculation amount of evaluation work. Based on the attribute mathematics, a comprehensive attribute evaluation system for prefabricated building construction safety is established for the prefabricated building. Combined with the concepts and methods of attribute mathematics, the index system of prefabricated building construction safety is analyzed and the screened index weights are determined.

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