ISSN: 2710-0170

Research on Construction Safety Risk of Prefabricated Construction Project

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Abstract

With the development of the construction industry and the vigorous promotion of national policies, prefabricated buildings have developed rapidly. Compared with traditional buildings, prefabricated buildings have the characteristics of fast construction, low cost and low pollution. The construction of prefabricated buildings has higher requirements for constructors and is more difficult to obtain professional skills. In particular, safety accidents are prone to occur during the hoisting of prefabricated components, resulting in casualties and economic losses. The safety risk in the construction of prefabricated buildings has become an urgent problem to be solved. This paper focuses on the safety risk analysis from the four aspects of manufacturing, transportation, storage and on-site assembly of prefabricated components in the construction process of prefabricated buildings, and gives the corresponding safety risk prevention measures.

Keywords

Prefabricated Building; Construction Safety; Risk Prevention.

1. Introduction

China's prefabricated buildings are developing rapidly, but compared with Western countries such as Europe and the United States, prefabricated buildings in China started late, and the research and application of construction safety risks are not much. There are still a lot of problems in prefabricated buildings in China in the manufacturing of prefabricated components, logistics transportation, on-site construction assembly, hazard identification at various stages of construction [1], and there is a lack of relevant safety technical specifications, The improvement of the system of prefabricated buildings is also being explored and practiced. In the absence of relevant safety management measures, imperfect risk assessment system, and lack of risk response measures, the construction of prefabricated buildings is still facing severe safety risks. Based on this, this paper mainly studies the safety risks in the process of production, transportation and construction of prefabricated buildings, hoping to provide help and reference for the risk prevention of prefabricated buildings.

2. Overview of Prefabricated Buildings

2.1. Construction Process and Classification of Prefabricated Buildings

Fabricated building refers to a new type of building construction mode in which prefabricated components are fabricated in advance according to the drawings in the factory and then transported to the construction site for assembly. For prefabricated buildings, the standardized and refined drawing design of components shall be carried out according to the requirements;

ISSN: 2710-0170

Then convert the drawing design into the specific task requirements of factory component processing, carry out production, and then transport the produced components to the construction site for assembly. It is a transformation of traditional architecture, just like the assembly of Lego building blocks or flow shop products. According to the form and construction method of prefabricated components, prefabricated buildings can be divided into block building, plate building, box building, skeleton plate building, and floor lifting building. Wood structure, steel structure, and concrete structure are all part of prefabricated buildings.

2.2. Features of Prefabricated Buildings

(1) A large number of construction components are produced and processed by workshops. The prefabricated building is different from the traditional cast-in-situ construction. For example, the wall, window frame and other components of the building are all completed through the automatic production of the production workshop.

(2) The workload and staff on the construction site are greatly reduced compared with the traditional cast-in-place building construction. As long as the components are built and spliced into a solid building on the construction site of prefabricated buildings, compared with the traditional cast-in-place buildings, the components are manufactured in the production workshop, not stacked on the site one brick at a time, so the on-site workload and staff are greatly reduced.

(3) The integrated design and construction of decoration can be carried out simultaneously with the main construction. The prefabricated building can realize the design of integrated decoration through BIM modeling. The design of architectural scheme and decoration scheme can be carried out simultaneously to meet the personalized needs of consumers.

(4) The standardization of design and the informatization of management make components more standard, higher production efficiency and lower production cost. Through standardized construction design and automatic component production, it is more standard and refined than traditional cast-in-place manual stacking

(5) In the construction process, there is little pollution and dust, meeting the requirements of green construction. In the construction process, like building blocks, it is mainly the splicing of semi-finished components, which reduces the dust and pollution caused by block cutting and building material painting.

3. Construction Safety Risk Analysis of Prefabricated Buildings

The prefabricated building is mainly divided into three stages, from the fabrication of prefabricated components to the transportation of prefabricated components and then to the assembly of prefabricated components at the construction site. The following will analyze the potential safety hazards in the construction process of prefabricated buildings from these three stages.

3.1. Fabrication of Prefabricated Components

There are no relevant regulations and standards for the fabrication of prefabricated components in China. The quality and size of components produced by each manufacturer are different. When using components produced by different manufacturers, safety accidents are very likely to occur due to the differences in the quality and size of components. When using accessories produced by different manufacturers, special personnel shall be assigned to negotiate and communicate with different manufacturers, standardize their production standards and strictly require them to produce according to the design drawings. During the production of prefabricated components, not only the supervision and management of internal personnel of the factory is required, but also the construction unit and the supervision unit

ISSN: 2710-0170

should be present. The three parties should establish a team to supervise, manage and communicate the production process of components to ensure the quality of components.

3.2. Transportation of Prefabricated Components

Before the transportation of prefabricated components, the road conditions should be investigated: whether there is height limit, weight limit, and whether the road conditions are bumpy, and then the route should be planned to prevent such conditions from delaying the transportation of components and causing damage to the structure of components. There should be a special frame on the vehicle transporting the components, and measures should be taken to protect the stability of the prefabricated components. At the same time, flexible protective plates should be placed at the places where the components are easy to bump and at the connections. During the transportation of prefabricated components, the vehicle shall stop for inspection at regular intervals. If the prefabricated components incline, deform, or the anti-skid pads fall off, they shall be bundled and reinforced in a timely manner. In the process of driving, the vehicle speed shall be kept as stable as possible to avoid collision between components caused by emergency braking and emergency stop. During the loading and unloading of prefabricated components, care shall be taken to avoid collision of prefabricated components, which may damage their quality and structure and affect the subsequent construction safety.

3.3. Storage of Prefabricated Components

After the prefabricated components are transported to the construction site, a reasonable area shall be selected to place and store the prefabricated components [2]. The area is divided into different small areas to store different types of prefabricated components. The area where components are stored shall be separated from other construction areas, and a safe working distance shall be reserved from other types of work to avoid impact on other construction work. In the process of area selection, attention should be paid to avoid component collapse caused by soft soil. Before component storage, impact roller can be used to harden the soil to make the storage site flat and compacted [3]. At the same time, drainage facilities shall be provided in the area where components are stored to prevent affecting their structural performance.

3.4. Assembly of Prefabricated Components at the Construction Site

The assembly of prefabricated components is a very important process in the construction process of prefabricated buildings [4]. Compared with the traditional cast-in-place construction, it reduces the number of personnel and construction processes, but also puts forward higher requirements for the quality and technology of on-site construction personnel. Most of the construction site managers and constructors in China have been used to extensive construction methods. At the same time, the education level of migrant workers is generally low. They do not know about the construction of prefabricated construction projects and lack relevant knowledge, which makes prefabricated construction projects frequently occur in the construction site.

4. Construction Safety Risk Factors and Risk Prevention of Prefabricated Buildings

The construction safety risk factors of prefabricated buildings include accidents caused by human factors, selection and maintenance of hoisting equipment, power use accidents, construction management and environmental factors. The following describes risk prevention from these factors.

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4.1. Accidents Caused by Human Factors

The assembly of prefabricated components on the construction site mainly occurs in high-altitude hoisting, which can not be used to build scaffolding indoors or outdoors like traditional cast-in-place construction, and is prone to safety accidents. During hoisting, ground workers do not wear or do not wear safety helmets correctly, and high-altitude workers do not wear safety belts correctly, which may easily cause casualties. During the operation of the lifting equipment, the operator does not operate in a standard way [5], which will cause the component to shake substantially; The cooperation between the ground staff and the high-altitude operators is not tacit, which will increase the potential construction safety risks if the prefabricated components are scratched and shaken during high-altitude hoisting. Before the hoisting operation, we should strengthen the safety publicity, organize workers to watch the construction safety publicity video3s regularly, pull banners at the construction site for warning, print the standard operation manual and other ways to make workers know the danger and horror of engineering accidents. The safety awareness of workers shall be established to ensure that workers strictly abide by the procedures, rules and regulations and correctly wear safety protection measures during construction. At the same time, an assessment system should also be established. Workers must pass the assessment before they can participate in the on-site construction. The principle of working with certificates should be followed. It is strictly prohibited to have certificates inconsistent with people.

4.2. Selection and Maintenance of Lifting Equipment

The reasonable selection of hoisting equipment during hoisting plays a vital role in the success of hoisting [6]. If the selected model is too large, it will cause waste of resources and increase costs; If the selected model is too small, the construction period will be delayed, and the prefabricated components may shake in the air and cannot be assembled due to insufficient estimation of the lifting height, increasing the risk of construction. Unreasonable and unscientific selection of lifting points during hoisting may make the components unable to be assembled. At the same time, the failure of connecting parts, the aging of slings and ropes, and the failure of machinery during the hoisting process will cause safety accidents. Before hoisting, a reasonable crane shall be selected according to the quality, volume and construction height of prefabricated components. At the same time, the slings and machinery shall be inspected and maintained to avoid construction safety accidents caused by aging of slings and mechanical failures. Calculate the maximum bearing capacity of the lever arm and maintain the stability of the lever arm to prevent the crane from breaking due to excessive component quality. When selecting the location for placing the crane, we should also pay attention to the hardening treatment of the soil to avoid the inclination and collapse of the crane caused by the soft soil during the hoisting process, which will cause casualties and economic losses.

4.3. Power Use Accident

In the process of component hoisting, each construction link will use electricity. However, the ground staff placed and dragged the cables and electrical equipment at will to save time and effort, which caused the abrasion and aging of cables and shortened the circuit. In this regard, an electric power team can be set up to be responsible for the design and planning of the circuit, and to regulate the placement and use standards of wires, temporary electrical boxes and electric equipment. At the same time, the power team regularly checks the power supply and lines to prevent casualties and losses caused by aging lines.

4.4. Construction Safety Management Factors

The number of accidents in a project is closely related to the management of the construction site. Every year, a large number of safety accidents occur due to management negligence and

ISSN: 2710-0170

irregularities [7]. A good project manager can effectively manage the construction site to avoid many accidents.

Before construction, hazard sources shall be identified and analyzed, and safety protection measures shall be strengthened during construction with frequent accidents. In addition, emergency plan shall be formulated for hazard sources, and relevant responsible person shall handle the accident when it happens, and report to relevant departments and superior leaders quickly to avoid further expansion of the situation and further occurrence of hazards. The management of the construction site is chaotic, and everyone's responsibility is ambiguous. When something happens, no relevant department or person is directly responsible for handling it, and everyone prevaricates. By contrast, in the management of the construction site, it is necessary to clarify the responsibility, authority and scope of each person, and establish a safety production responsibility system to implement the rights and responsibilities to individuals.

Workers and managers have many violations and operations on the construction site. Therefore, an inspection team can be set up to conduct regular inspections and standardize workers' behaviors. It is strictly forbidden to smoke while working, drag cables at will, improperly wear safety protection measures, and operate machinery improperly. On the construction site, the construction unit shall set up warning signs or enclose the site with iron mesh in the site and gray area according to the construction situation. It is strictly forbidden for irrelevant personnel to enter the site to avoid accidents.

4.5. Environmental Factors

Both the traditional cast-in-situ construction and the emerging prefabricated construction have strict requirements on the building environment [8]. As most of the construction of prefabricated buildings takes place in the process of high-altitude hoisting, they have more strict and demanding requirements on the weather. In windy weather, the hoisting of prefabricated components in high altitude may sway and fall due to the influence of wind; In rainy days, the visibility becomes lower, and the ground and high altitude force points become more slippery, which will increase the difficulty of construction, cause members and personnel to fall, and cause safety accidents. When severe weather comes, the protection of the construction site shall be strengthened to avoid construction as much as possible.

5. Conclusion

The development prospect of prefabricated buildings is very broad, with short construction period, manpower saving, green and environmental protection, accounting for an increasing proportion in the construction industry. However, due to inadequate safety risk analysis and incomplete risk prevention measures for domestic prefabricated buildings, safety accidents occur frequently in the construction process of prefabricated buildings, which brings huge losses to personnel and economy. Therefore, the safety risk problems in the construction process of prefabricated buildings need to be solved urgently. This paper mainly analyzes the hazard sources of prefabricated buildings from the four stages of production, transportation, storage and on-site assembly of prefabricated building components, and gives corresponding measures to provide reference for the construction of prefabricated buildings.

Acknowledgments

Funded by the Innovation and Entrepreneurship Training Program for College Students of Anhui University of Finance and Economics (S202110378226).

ISSN: 2710-0170

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