

Application of Wood Structure in Prefabricated Building Construction

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Abstract: Since the founding of the People's Republic of China, China's industrialization has made comprehensive development. While brilliant achievements have been made in industrialization, China's environmental problems have become more and more prominent. Therefore, under the current trend of building transformation, prefabricated construction will become an important way for the civil engineering industry to achieve high-quality development. Wood structure has a long history in China. As one of the application forms of prefabricated buildings, wood structure has been widely used in developed countries. In recent years, the application of wood structure in prefabricated structure has also been widely concerned in scientific research and application fields in China. This paper mainly focuses on the research of wood structure, namely, the performance and processing of new materials, the performance and innovation of components, the research and development of system, and the connection performance and progress. Through these studies, the research trend of wood structure for the application of prefabricated buildings in the future is explored, which can provide reference for future research work and prospect the application progress of wood structure in prefabricated buildings.

Keywords: Timber structure, Assembly type, Construction engineering, Intelligent building

1. Introduction

As a pillar industry in China's national economy, the construction industry plays a key role in China's positive development. Under the background of high development of science and technology and industry in China as the world's largest developing country, the sustainability of environmental ecology and the maintenance of large population have become the key problems in China. In the critical period of reform and development, environmental problems are becoming more and more obvious under the rapid development of economy. China's requirements for green construction in the construction industry are increasingly strict and people's requirements for life and housing quality are generally improved. The traditional concrete construction method can not meet the requirements. In recent years, China has vigorously developed prefabricated buildings. Prefabricated buildings have the following advantages (1) saving resources (2) shortening the construction period (3) saving labor and reducing project cost (4) ensuring engineering quality (5) good application performance (6) reducing the impact on the surrounding environment. Based on the above advantages of prefabricated buildings, it has become a hot spot in the field of technology in the construction industry. Wood is recognized as a green material, which has the advantages of recyclable and low pollution. If the combination of wood materials and prefabricated buildings is realized, the environmental pollution and labor force can be reduced. Based on the particularity of materials used in prefabricated buildings, the demolished building materials can be recycled to change the traditional architectural mode[1]. On the premise of improving the construction quality and safety, improving the construction efficiency and reasonably shortening the construction period are more environmentally friendly and energy-saving, which is conducive to the green and efficient development of China's construction industry. It is better to implement the concept of "green water and green mountains are golden hills" and optimize the allocation of pastoral landscape resources[2][3]. In the past 10 years, the research on modern wood structure in China has shown rapid growth. Trend, research work has been more perfect, in materials, components, connections, body Significant progress in department, fire protection and durability, standard specification System tends to be complete, the whole industry chain is becoming more and more perfect, engineering application increased year by year More. Therefore, in view of the domestic and foreign research progress in the field of modern wood structure Sorting out, systematically summarizing and summarizing the divisions of modern wood structure in China Research Status of Branch Fields for the Study of Modern Wood

Structure in China And applications provide reference.

2. Analysis of assembled wood building

The research object of this paper is located in the 'assembled wooden building', which is explained separately. Compatibility refers to the construction process, on the other hand 'wood construction' which contains both the meaning of 'wood structure'. It also includes the use of 'composition' and 'structure' material decoration levels for wood material properties. Wooden architecture in the research perspective of modern architectural types, more attention is paid to the 'architecture' level rather than the 'structure' level. Pack Mating building refers to the architectural form of factory production and processing, on-site assembly. Now the pace of industrialization is constantly increasing Fast, and prefabricated buildings play the role of carriers in diversified buildings. The focus of this paper is the modern wooden architecture, wooden architecture in the 'structure' word structure, composition and structure

Multiple meanings. It is two distinct structural systems from ancient wooden architecture. What needs attention is that wood When it is a structural system, wood composite plates or processed logs and sawn wood are generally used, with wood as the filling part. Usually auxiliary wood or steel member in the connecting part ; when wood is used as a structural material, it refers to wood in rebar Buildings widely used in concrete or steel structures. The new wood not only has high strength and corrosion resistance And to a certain extent, it can play a role in fire prevention, which is much higher than the unprocessed logs of ancient wooden buildings, promoting Modern wood construction industry development, in line with the spirit of low-carbon environmental protection era.[1]

3. History of Chinese traditional wooden architecture

Wooden structure building refers to the building built with wood as raw materials, (strategy research) found tenon technology in Yaohemudu village ancient building sites for components of the building, in the same historical stage, the late Shao culture also has similar wood structure building. In the feudal society of Qin and Han Dynasties, there are a series of standards and design and construction norms so that the quality of buildings is better guaranteed. The appearance of these buildings also highlights the unique aesthetic and national culture of ancient Chinese architectural aesthetics. During the Yuan, Ming and Qing Dynasties, due to the perennial outbreak of war and the destruction of forest resources, people began to improve the wooden structure. There are records of the improvement of architecture and furniture technology in the Ming Dynasty in the book 'Luban Creates Formal', which is popular among the people.[4] Technical faults appear in modern wood structure buildings. From the Opium War to modern times, the official technology of the government was basically at a standstill stage. Only remote mountainous areas and some ethnic minorities still had some research and development on wood structure, but less innovation basically followed the previous wood structure. Since the founding of the People's Republic of China, the state advocates 'returning farmland to forest', and there are only some experimental buildings in wooden structure buildings.[5]

4. History of foreign wooden structure buildings

4.1. History of Japanese wooden architecture

In Japan, another country in Asia, most of the wood buildings in Japan are well preserved under the influence of Chinese wood buildings, and their buildings are affected by the Shintoism. Japanese believe that wood as a natural material has the characteristics of endless life to give new life to the built buildings. In the period of peace, Japan's architectural era reached its peak and gradually formed its own architectural style. The relatively famous style is the outstanding architectural works represented by the Equality Institute and the Phoenix Hall. In the 12-16th century A.D., Japan's clean warehouse era and room staring era, the building from the 'dormitory building' has gradually become 'wujia building' pay more attention to carving technology. In the Edo era of 1573-1867 A.D., the architectural style of Europe gradually affected the local style of Japan, mostly concrete buildings. After 1867, Japan carried out large-scale architectural style innovation, the rapid development of Japan's economy, thought that the rise of western architectural style of Japanese architecture has many new buildings with western architectural characteristics. After the great earthquake in 1923, Japan began to use a large number of concrete buildings, which made wooden structures eliminated.[4]

4.2. *Wooden architecture history of Canada, North America*

The United States is rich in forest resources, so the wood structure buildings in the United States are also very prosperous. The early American wooden buildings were relatively primitive. After the independence of the United States, the economic development was very rapid, so the wooden buildings were divided into wooden houses, frame houses and column houses[4].

In North America, the earliest wooden wall buildings were built by European immigrant colonists. Colonists from different parts of Europe built different forms of wooden structures, such as the famous Greek Revival style, Italian style and Stick Style (appeared in the 1850 s and 1860 s, which is characterized by the combination of slate steep roof and metal decoration, and the use of a large number of wooden strips and geometric decorative patterns on the exterior walls). At present, the design of many houses still has the characteristics of European design. The earliest inclined roof residential form in the eastern part of the Americas in 1874 was designed by the architect Richardson, whose characteristics include the use of a large number of panels on the exterior walls of buildings and the use of large inclined roofs, which can fully reflect the characteristics and texture of wood.

At the same time, due to the expansion and vigorous development of sawmills and nail factories, the wooden building structure gradually evolved into a small-sized cross-section of wood components, with simple lines, no longer using complex ancient art style of wood building form. This wooden structure is framed by a lightweight wooden skeleton. In recent years, due to the development of composite technology, the early wall with a large number of small section solid wood approach has gradually evolved into a shear wall-based structure. This construction method is an economical and efficient wood building form in residential buildings.[4]

5. Development trend of prefabricated wooden buildings

In recent years, with the wide promotion of wood materials in the construction industry, wood structure buildings have also ushered in great changes, and the pattern of modern wood structure industry discourse has gradually emerged.

Prefabricated wood structure building will improve the shortcomings and defects of wood structure itself, and it has been widely used in the United States, Canada, Europe and other countries. More beautiful steel structure wood villas are widely used in Europe, and steel structure wood villas have also appeared in many cities in China. This kind of building has the characteristics of warm winter and cool summer, good seismic resistance and beautiful appearance. Therefore, in today's society, people's requirements for the beautiful quality of life and housing are generally improved. At the same time, steel structure wood structure building is also encouraged by the government, and housing safety problems have been solved. The prefabricated steel structure wood building can be produced through a unified factory assembly line. The centralized prefabricated production has generally improved the quality and efficiency of the building, and has good structural performance and low artificial consumption. It reduces the pollution to the environment, solves the problem of labor shortage in China in recent years, and promotes the transformation and upgrading of the construction industry from labor-intensive to technology-intensive.[6]

6. History of Chinese traditional wooden architecture

6.1. *Prefabricated wooden buildings of folk residence (customized ocean house)*

Customized ocean house has more advantages than traditional concrete ocean house in seismic wind resistance and environmental protection. The force system of the house is cold-formed thin-walled light steel structure, and the weight is only $1/3 \sim 1/2$ of the traditional building. It greatly reduces the construction project, reduces the project cost and labor force, and saves the cost. The wooden structure commonly used in earthquake zone is building structure. Prefabricated wooden buildings adopt green environmental protection materials and reduce pollution to the surrounding environment.

For high-end custom-made cottages, prefabricated wooden buildings are more personalized and diversified than traditional reinforced concrete buildings, such as Europe, North America, Victoria, pastoral, modern and Chinese style. More able to meet the personalized needs of the owners.

The assembly of wooden buildings greatly improves the utilization rate of materials, the mechanized

operation of pipeline work greatly reduces manual work, the project progress is fast, the construction period is reduced, and the economic development is promoted[6].

6.2. Mobile building

With economic development, mobile buildings are also gradually emerging. Mobile buildings can quickly assemble, disassemble and move temporary buildings. Nowadays, mobile buildings have been equipped in tourist areas, public buildings in cities, isolation areas of temporary infectious diseases and treatment areas.

Mobile buildings can be customized and assembled according to the construction needs. Different sizes, areas and floors can meet different needs. Compared with the traditional construction method, factory production site assembly can realize the rapid prototyping of prefabricated buildings.

According to the needs of social development, mobile toilets as a kind of rapid assembly, rapid put into use, small footprint, reduce the construction pressure and greatly save manpower, material and financial resources in the construction, the construction of traditional toilets usually need to go through site selection, purchasing materials, construction, completion, put into use, etc., and mobile toilets are finished products produced by manufacturers, direct installation can be used.

Changbai Mountain has a special wooden sports club. The building has novel shape, unique appearance, good lighting and thermal insulation performance. During the construction of small noise, dust pollution for the surrounding especially such as Changbai Mountain and other important natural protection landscape natural environment less broken ring can basically achieve 'zero damage' and a high proportion of building materials can be recycled.

Mobile housing has high protection, high practicability and long service life. Different from traditional steel concrete, wood is the material with the best strength-weight ratio. Its strength is three times that of traditional concrete and four times that of steel[6].

7. Characteristics of assembled wooden structure building

Prefabricated wood structure building refers to the main wood structure bearing components, wood components and wood parts prefabricated in the factory and formed by on-site installation. Through the analysis of modern wood structure construction engineering, its characteristics can be summarized as the following points.

With high-level management measures, the processing mechanism of timber building materials is constantly improved. It is believed that in the near future, the construction industry will surely create a complete recycling chain of timber building materials.

Assembled construction timber structure is not constrained by its own size in design, which makes the design flexibility very strong. This feature can well meet the diversity of design requirements, and then make it more convenient in transformation. This advantage enables the wooden structure to be prefabricated in advance in the factory and then assembled in real time at the construction site, which is not affected by climatic conditions and seasonal changes, and can minimize the error of component specifications to the greatest extent, reduce the negative effects of pre-assembled components due to errors in actual assembly, thereby effectively improving construction efficiency, reducing labor costs, and improving the industrial production level of wooden structures.

Strong safety and stability With the development of prefabricated buildings, workers increasingly demanding working environment, the improvement of modern construction technology also makes the occupants of the housing security and stability demand rising. Modern prefabricated wood structure buildings have a strong competitive advantage in seismic safety, fire safety and other aspects. Due to the relatively small quality and strong toughness, wood structure buildings can effectively slow down the instantaneous impact, payload and absorb energy, and can also significantly alleviate periodic fatigue damage. The carbonized layer of wood structural components has a strong protective effect. The unique microporous structure of the material itself makes it have a low thermal conductivity, which can greatly improve the fire resistance. At the same time, the interior of the wood structure has the characteristics of convenience in modification. The fire prevention ability can be improved by installing the automatic sprinkler system, increasing the fire prevention interval and controlling the fire spacing.

Compared with any other building material structure, the thermal insulation and energy saving of

light wood structure is the best choice. The porosity of the wood material makes the external wall and the air combine to form an insulation barrier. The wood itself is an excellent insulation body. Under the same conditions of length, width and thickness, the heat insulation value of the wood is 16 times higher than the heat insulation value under the qualified standard of concrete, 400 times higher than the heat insulation value of steel, and 1600 times higher than the heat insulation value of aluminum. At the same time, the biological characteristics of the wooden structure can well play its own biological material characteristics to adjust the indoor humidity to absorb moisture in the southern rainy season environment, and the indoor drying can release water to ensure the air humidity, so that the occupants can experience the real 'warm winter and cool summer' feeling. Not only that, the pure natural color characteristics of the wood structure can be well reconciled with the light inside and outside the house, so that the diffuse light soft relatives, echo the decorative color, to bring residents to integrate the natural experience and enhance the sense of belonging[7].

8. Research key points of prefabricated wood structure

In the period of rapid development of modern technology, compared with developed countries such as Europe and the United States, China should pay more attention to environmental protection issues in the construction process, vigorously study and develop environmentally friendly materials, and better implement the concept of "green water and green mountains are golden hills". Further research is needed for the inheritance and development of prefabricated wood structure buildings for building thermal insulation, roof floor optimization and traditional structure.

9. Conclusion

The assembly building adopts factory prefabrication, on-site assembly and simple assembly to speed up the installation and construction. Prefabricated wooden buildings are more environmentally friendly and materials-saving, more beautiful appearance, and meet most of the needs of customers.

At present, China has vigorously promoted prefabricated steel-wood structure buildings, which is in line with the national development plan. The roof structure, fireproof materials and more stable structure are still to be studied.

Some developed countries in the world, such as Canada, the United States and Japan, have established standard wooden building codes. Prefabricated buildings have also developed more mature, which is the institutional basis for ensuring the standardization of the construction industry. Currently China's existing standards and norms of wood construction are not comprehensive. There is a large gap between foreign norms. Therefore, a more systematic and suitable wood structure building standard system needs to be formulated and improved. Only by establishing a perfect wooden structure building standard system, can we connect the architects, supply enterprises and construction units to promote the formation of a set of standards, and let the wooden structure building really be promoted.

To study the design of wood structure, break the information barrier of wood structure technology and designer, establish the wood structure building standard, this normative system can promote the wood industry to meet the expectations of the current society and industry, and inherit the traditional context of wood structure architecture[1].

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