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Study on Predicament and Countermeasures of Popularization of Prefabricated Building in China

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Abstract. The implementation of prefabricated building is an important measure to realize the industrialization of construction and promote the transformation and upgrading of construction industry. This paper reviews the history of the development of the assembly architecture in China, analyzes the difficulties in the implementation of the assembly architecture from several aspects, such as cost, standardization, lack of talent, the model of the contract and the chain of industry and so on, and puts forward some Targeted suggestions.

Introduction

The prefabricated building is to split the building into small modules and perform prefabricated construction and parts in the factory. After the Production is completed , these components will be transported to the construction site for installation and connection. In the construction process, the use of formwork, cement, and gravel is greatly reduced, It accords with the development way of green building, can promote the transformation of construction industry, and is conducive to the realization of building industrialization[1].Assembled building is the representative of the new round of construction science and technology revolution, and it is also the direction of future development of construction industry. In the process of reforming traditional construction methods and industrial transformation, it can not only promote structural reforms on the supply side, but also promote the construction of new urbanization. In recent years, China has been active in the development and exploration of fabricated buildings, but it also encountered some difficult problems to be solved in the design of technical specifications and top-level standards. This makes China's relevant standards have a certain gap compared with the international advanced standards. China's assembly building still has a long way to go[2].

Development and Present Situation

Development and Present Situation of Assembly Architecture in Foreign Countries

Europe's early attempts at prefabricated buildings date back to the late nineteenth Century. In 1867, Joseph Monier invented the patent technology of reinforced concrete, which made it possible to produce fast and cheap prefabricated components, and soon the concrete prefabricated components were applied to the actual construction. This is the early prefabricated building in Europe. Before the Second World War, the European assembly structure mainly consisted of solid component assembly system, which was connected by welding, bolt and grouting. Although this assembly system has many advantages, it also has the drawback of weak seismic capacity. After the Second World War, a large number of houses were damaged. Especially in Germany, housing shortage became a social problem at that time. Against this background, with the recovery of post-war economy and the development of science and technology, fabricated buildings have been developing rapidly[3].

At present, Germany has developed a systematized, standardized, high quality and energy-efficient assembly house system. In terms of building energy consumption, the reduction speed of building energy consumption in Germany is the largest in the world. Sweden is the most

widely used country in assembly houses in the world, and its fabricated housing accounts for 80% of the total. They have a complete system of technical standards, the standardization of the assembly building department products and components has been gradually incorporated into the national industrial standards, and the products produced have good generality and combination. The concept of Assembly building in Japan was born in 1968. After decades of exploration, Japan has now had a perfect technical system (KSI Architecture). At present, the assembly building in Japan is more than half of the market. France is the pioneer of the assembly building promotion, and they started to use precast concrete more than 130 years ago. At the present stage, there are three types of assembly buildings in France, including steel, wood and prestressed concrete. The prestressing concrete frame structure system is the main structure, and the assembly rate of the house can reach about 80%. Singapore has a narrow land area and a tight housing land, to solve the problem of social housing shortage, Singapore began its road of building industrialization in the 60s of last century. Under the impetus of the government, Singapore has been moving forward on the road of housing industrialization. Although the process of development has gone through several failures, after continuous study and attempt, Singapore has finally found a method of industrial architecture suitable for its own national conditions[4].

The Development of Chinese Prefabricated Buildings

As early as the 50s of last century, prefabricated buildings began to rise in China and developed rapidly because of the advantages of fast construction and low price. In the late 80s of the last century, the national real estate industry flourished, and the construction cost of the assembly building was high and not too flexible, and its structure itself was not perfect in the aspects of earthquake resistance and waterproof. It was also difficult to coordinate the work in the construction. Therefore, it was replaced by the Cast-in-place structure, and a large number of prefabricated components factory closed. The situation continued until 2014[5].

In September 14, 2016, the state Premier Li Keqiang held a standing meeting of the State Council. The participants agreed that to promote the structural reform of the supply side and the development of a new type of urbanization, the construction industry should be vigorously developed, especially the new buildings, such as steel structures and precast concrete structures, so as to realize the construction industry Structural adjustment and upgrading to solve the problem of excess capacity. The assembly building once again welcomed the development opportunities and began to rise rapidly[6].At present, the prefabricated buildings in China are mainly divided into three categories: timber structure, steel structure and precast concrete structure. The wood structure has poor performance in corrosion resistance and fire protection, which limits its development and application. The steel structure system has a long time application in our country, and has a large amount of technology and experience accumulation. The precast concrete structure has good structural properties and can be widely used in the construction field. However, the development of precast concrete structure in China is still in its infancy, and many technical specifications and standards are still being explored[7].

At present, China is vigorously promoting the process of building industrialization, and has made many attempts and active explorations in the development of fabricated buildings. But the current construction method is mainly on site pouring, the proportion and scale of assembly building are low, and the assembly building projects in the construction are mostly concentrated in the narrow area of affordable housing, schools and industrial buildings, and there are still many difficulties in the promotion.

Assembled Building Promotion Dilemma

The Industrial Foundation is Weak and the Cost is High

High cost has always been the main problem that restricts the development of fabricated buildings. At present, the cost of prefabricated structure is slightly higher than that of cast-in-place structure. There are three main factors that affect the price of fabricated buildings: production, transportation

and site installation, among which the production of PC is the most important factor.

At present, China's assembly construction industry is still in the initial stage of exploration, and the industrial foundation is relatively weak. In the past ten or twenty years, a large number of prefabricated components factory closed. Although the present stage of assembly architecture has developed rapidly, it has not yet formed an industrial base with large scale, strong production capacity and mastering frontier technology. In terms of current market share, fabricated buildings occupy a relatively small proportion in the construction market, mainly concentrated in government funded housing, schools and other projects. The market of assembly building is not yet mature, and there is little demand for prefabricated components. At present, the standardization of precast components is low, the versatility is poor, and mass production can not be made. It is difficult to form scale benefit.

The transport and stacking of components will increase the cost. The assembly building components are produced in the factory. After the production is completed, it is not immediately transported to the construction site, but is stored in the factory, so there will be two transport in transportation, which will also produce a part of the cost. Worse still, in transportation and stacking, it will cause damage to the components due to improper operation and increase additional engineering costs.

The construction operation needs to use a large number of machinery, the present assembly construction market lacks skilled technical workers. Many workers are not familiar with the assembly construction process during the construction, which will not only cause the low construction efficiency, but also cause the increase of the mechanical cost.

Lack of a Perfect Standard System

The foundation of construction industrialization is standardization, "Assembly building evaluation standard" was formally implemented in February 2018,it has an important role to regulate and guide. However, because of the lack of basic research and sufficient engineering practice for the technical standards of construction industrialization, many technology lacks detailed implementation rules and some technical standards are still in blank. Uniform industry norms and standards across the country, wide application of modular standards and complete technical standards system have not been established. The product, structure and technical system are still in the preliminary exploration stage, and the standardization construction is lagging behind. At present, in the entire prefabricated construction industry chain, the reference standards are mainly compiled by enterprises, Product categories and technical standards are different, which brings many problems for project design, approval, construction and acceptance[7].

There are Drawbacks to the Contracting Model

The construction of the whole industrial chain of the assembled building is a complex systematic project. In the process of construction, it is necessary to have a suitable engineering management mode. At present, China's assembly market is not yet mature, and the separation of design, production and management has not really formed the upstream and downstream industry chain. Design institutes cannot consider the splitting of fabricated components at the design stage, most of the component manufacturing companies are manufacturing assembled components according to their own assembly and connection system after getting the drawings of the construction unit designed according to the cast-in-place structure. The components produced in this way often have their own characteristics. The universality is very poor, which limits the development of the industry, and it is difficult to form scale benefit, resulting in waste of resources[7].

The Quality Supervision System is not Yet Sound

The fabricated building is different from the traditional cast-in-place building. Therefore, the management mechanism should be changed correspondingly to meet the needs of the development of fabricated buildings. At present, the field management of fabricated buildings in China is still in the exploratory stage, lacking relevant knowledge storage and engineering practice experience [8].

Extensive management exists in the construction site, and there is no perfect management system. In the management of EPC, the regulatory mechanism matching EPC mode is not sound enough. With the EPC model, related systems involving project bidding, enterprise qualification management, drawing system, cost quota, project supervision, quality inspection and completion acceptance are still not perfect, and the government needs to be improved. For example, EPC project contracting and tendering system need to be reformed from the legislative level[9].

Lack of Professionals and Industrial Workers

The transformation of the building industry is also accompanied by changes in the demand for professionals. Compared with the traditional construction industry, the assembly building has higher requirements for construction technology, and is a technology intensive industry. While the traditional construction industry is extensive development, the workers are mainly farmers, therefore, the entire industry chain needs to be improved in terms of technology, management, and personnel quality[10].

At present, the construction management system and the talent training mechanism of our country do not meet the needs of the development of assembly architecture. There is no "prefabricated" specialty in the universities and colleges in the country, and there is no channel for the training of technical workers[11].College education is mainly based on traditional architectural theory, there is very little professional teaching in prefabricated buildings. Many students lack understanding of prefabricated buildings, and even college teachers lack practical experience. The talent team is extremely lacking. The task of training skilled building-type construction talents is arduous.

Lack of a Perfect Industrial Chain

At present, the assembly building in our country is still in the initial stage of exploration, and the industrial chain is not perfect. There are few design institutes specializing in prefabricated building design, the manufacturers of prefabricated components are inadequate and the components are single. So, It is difficult to meet the needs of the market without forming a large market size. In terms of transportation logistics, there is a lack of supporting logistics systems. In terms of construction, there is a lack of professional industrial workers. The industrial chain of construction product design, production, transportation and construction is not perfect, and there is no coordination organization and lack of effective information communication.

Strategy Research

Establish and Improve the Standardization System, Take the Specialized Production and Construction Road

To develop prefabricated buildings, the most important thing is to establish a complete standard system. Learn from the advanced foreign technology experience, and combine some characteristics of its own development, formulate a master plan for the development of prefabricated assembly building. And refine the points and write specific implementation details. The assembly construction industry must have specific standards for planning and design, product production, transportation, and on-site construction and installation to achieve standardized production operations. Only in this way can the industrialized production of prefabricated buildings be formed, thereby reducing costs, generating economies of scale, and promoting the development of the building industry.

Improve the "specialization" level of prefabricated parts manufacturers and construction companies and improve the quality of products and construction. Through specialized production, component manufacturers can continuously improve their processes in production, carry out product innovation, and improve product quality. There are many problems in the current prefabricated construction projects caused by poor product quality. Similarly, specialized construction will also enable workers to continuously improve construction skills and construction

proficiency, improve construction quality, shorten construction period, and reduce project costs.

Improve Industry Standards and Strengthen Supervision of Construction Quality

At present, the rapid development of prefabricated buildings has led to many policy lags. The government needs to further improve the relevant policies, regulations, and regulations so that it can truly harmonize with the development of prefabricated buildings and the industrialization of buildings. To standardize all aspects of the prefabricated construction industry, the tendering specifications for the EPC model of prefabricated buildings still need to be improved. Only in this way can we build nests and attract phoenixes, attract more capital, technology and talents to enter the assembly-type construction market, and promote the development of assembly-type buildings and building industrialization.

In February of this year, the State issued the "Evaluation Criteria for Assembled Buildings", which mainly proposes methods and indicators for the evaluation of prefabricated buildings in terms of construction methods, basic performance, and functions. All regions should actively formulate regional standards in accordance with the "Prefabricated Building Evaluation Standards", and strictly control the quality and acceptance.

Accelerating the Training of Prefabricated Building Talents

Technical training is conducted to train skilled workers in the industry and improve the quality of workers so that they can master the professional knowledge and skills of prefabricated construction management. At the same time, we will set up assembly-related courses in major undergraduates, colleges, and vocational and technical schools, and formulate scientific training plans based on the characteristics of prefabricated buildings to accelerate the construction of prefabricated construction talents. School-enterprise alliances make full use of social resources to promote the development of prefabricated buildings. Universities and research institutes can understand the status of prefabricated buildings and raise the level of awareness through companies. Universities and research institutes can understand the status of prefabricated buildings and raise the level of awareness through companies. Enterprises can also make full use of scientific research and human resources in universities to promote enterprise development.

Improve Prefabricated Construction Industry Chain

First, the government should formulate corresponding laws and regulations for the development of fabricated buildings. Improve technical standards and industry standards in all aspects of project financing, design, product development, production, retail, transportation, and on-site construction. Integrate resources, and make reasonable plans in the industrial layout, support leading enterprises, in order to promote the development of the industry, and form a complete assembly-type construction industry chain.

Conclusion

With the transformation and upgrading of China's economy and industrial structure, the development of prefabricated buildings is a general trend. At present, China's prefabricated buildings have developed rapidly, but they are still at an initial stage of exploration. Low standardization, defects in the contract delivery model, imperfect quality supervision, imperfect industrial chains, and lack of talents still exist. It is necessary to establish a sound assembly construction standard system, take specialized production and construction roads, strengthen quality supervision, improve industry standards, accelerate personnel training, and improve the construction industry equipment industry chain. This will promote the development of the prefabricated construction industry and the industrialization of buildings.

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