

Research on the Housing Industrialization to promote the Development of green Building in China

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Abstract. We analyzes the conjunction point of the housing industrialization and the implementation of green building in China according to the research of the problem of the construction industry energy consumption in our country combined with the present situation and characteristics of the development of the housing industrialization. It solves the problem of the housing industrialization development to meet green building goals. We also get a research on the countermeasures of promoting the development of green building in the residential industry.

Keywords: the Housing Industrialization; Energy Consumption; green Building.

1. Introduction

After the 18th National Congress of the CPC, the Party Central Committee made the strategic decision of “vigorously promote the construction of ecological civilization” and made a blueprint of it from many aspects, one of which is the promotion of green building. Green building was first proposed by Robert and Bernda Vale at the United Nations Conference on environment and development. In 2004 August, China promulgated the relevant administrative regulations on green building and green building was given a clear definition. The connotation of green building mainly refers to as far as possible the use of green building materials and equipments; save resources, reduce energy consumption; control of the construction process, reduce environmental pollution; with scientific management methods and construction technology to achieve the construction products of safe and reliable, economical and applicable^[1]. Comparing with traditional form of construction work, industrialization has advantages of saving materials, reducing construction waste and reducing pollution and so on. It is an effective way for the development of green building.

2. The present situation of energy consumption in the construction industry

2.1 The present situation of energy consumption in the construction industry in China

The three parts of China's energy consumption mainly include building energy consumption, industrial energy consumption and transportation energy consumption. In developed countries, building energy consumption accounted for the total energy consumption of about 1/3. In China, along with the advance of urbanization, the rapid development of construction industry and the gradual ascent of building energy consumption, it could have accounted for the total energy consumption of 20% in China's construction[2]. Domestic building is not only the large energy consumption, but also the low energy utilization rate; its unit building energy consumption ratio is, under the same conditions, to 25% higher than in developed countries[3]. In recent years, the government encourages construction industry to go the road of green building and low carbon building, endeavoring to promote China's development of green city. In order to decrease the energy consumption of construction industry, China has released a series of building energy saving standards and planning, which includes “Civil Building Energy Efficiency Design Standard”, “Public Building Energy Efficiency Design Standard”, and “Regulations on the Civil Building Energy Efficiency”. The goals of setting new buildings' energy saving standards have been raised from 30% in 1985 to 50% in 2010, which directly brought enormous growth of areas in energy saving buildings, and the ratio of

town's energy saving structural areas has increased from 1% in 2001 to 20% in 2010. The government controls energy consumption through a large number of policies, but so far, the situation of construction industries' energy consumption is not optimistic.

2.2 The problems faced by building energy saving

Because of China's huge amount of buildings, the annual newly-increasing areas of structure are far more than any other developed countries' completed areas of structure; so it is hard to control building energy consumption. In addition, huge proportion of high energy consumption exacerbates energy consumption. For years, the government has been launching considerable scale's efforts to building energy conservation. So far, energy saving building is still in pilot stage. The condition of building energy conservation is urgently needed to be improved.

There are some primal problems faced by China's building energy conservation. The first problem is high development costs of building energy conservation and large investments in initial stage. For energy conservation buildings, part of technologies need to be changed. Adopting new construction technology would increase development costs. In addition, China is lack of attractive encouragement policies; developers have low positivity in investing building conservation^[4].

The second problem is that the system of building energy conservation is not systematic, the executive effect is terrible and the technology of energy conservation standards falls behind. The establishment of energy conservation system needs government to guide it and needs construction enterprises to cooperate with. So far, China's building energy conservation standards are lack of partitioning and improvement. The update of energy conservation standards is too slow to keep pace with construction industry's developments.

The third problem is that the coefficient of utilizing new technologies, materials and products in building energy conservation, while the new technologies, materials and products are keys to develop building energy conservation. However, so far, construction industry cannot update technologies in time and is unwilling to use higher cost's new materials and products. It impedes building energy conservation's development.

3. The present situation of domestic and foreign housing industrialization development

3.1 The development of foreign housing industrialization

Europe. After the industrial revolution, the industrial development of Europe is rapid; the industrial technology is updated and manufacturing leads in the world. Influenced by Ford Model T, Walter Gropius proposed the idea of housing industrialization in 1910. After the Second World War, Europe was on the huge demand for residences. In order to solve the post-war housing problem, many countries began to develop prefabricated construction, putting the components into factory production, and formed a set of systemic, complete and standardized industrialized building system. Since the 1980s, the housing industrialization development in Europe began to focus on the development of residential personalization and function. In France, Sweden, Denmark, the former Soviet Union and other countries, the housing industrialization development has reached a certain level.

France, in 1977, established ACC; and in the 1990s, residential general C5 component software system was drew up there. France is one of the earliest countries in carrying out housing industrialization. At present, the development of French building industrialization system is mature, and has started to develop from residential buildings to schools, hospitals and some other public buildings. Sweden's residential industrialization is the world's most developed, and its residential industrialization rate has reached 80%, which mainly used in villas and ordinary residential. Denmark's housing industrialization begins with "modular" legalization, and the direction of developing housing industrialization is the product catalogue design. For the former Soviet Union and other European countries, on the basis of its own economic conditions and social foundations, the direction of developing housing industrialization is mainly to promote the industrial production of

prefabricated components and general part to improve construction efficiency and to reduce the construction cost.

America. The development of American housing industrialization is different from European. Because America was affected little by the Second World War, as well as there was no urgent housing demands after the Second World War, America mainly pursued residential personalized functional development. American housing industrialization development gives priority to villa residence, monomer low-level timber structure, which means that to build residences through purchasing standard member from factory and through the live mechanized construction. American housing industrialization market is perfect and well developed. Its general parts have high degree of standardization and good business promotion. The advantage of it is that the building function can meet the demand of users, the efficiency is substantial, the resource utilization is sufficient, the energy consumption is low and the price is affordable.

Japan. Housing industrialization in Japan successively experienced from KJ component to BL(Better Living) component; from introducing American PC(Prefabricated Concrete) construction method to developing HPC(H section steel and PC board) on their own, releasing SPH(Standard of Public Housing) and NPS(New Plan System) design standards, researching and developing KEP(Kodan Experimental Housing Project) and CHS(Centural Housing System) residential building system. The Japanese housing industrialization develops rapidly through government's continuous investment research and updating technology. Through 30 years' development, by 1985, almost all of the Japanese residences adopted the new technologies and materials, as well as the residences constructed by adopting industrialization way accounted for 25%-28% among the total number of completed residences. The fast development of housing industrialization in Japan lays the foundation for the development of green buildings.

3.2 The development of domestic housing industrialization

In 1994, China first proposed the concept of housing industrialization. Since it was proposed, the government promulgated some relevant policy documents to promote the development of housing industrialization. About housing industrialization relevant policy documents are shown in table 1.1. In 2006, the Ministry of Construction promulgated the "Trial Measures for National Housing Industrialization Base". After a few years, three industrialization pilot cities of, dominated by the government, Shenzhen, Shenyang, Jinan, and two industrial parks of Hefei economic and technological development zone and Dalian Hua Yuan Kou economic development zone were approved. In 2014, Beijing and Xiamen were successively selected for modern industrialization integrated pilot cities. The government encourages the development of housing industrialization by setting up pilot cities and providing with some preferential policies. At present, China's industrialization construction proportion is about 7%, which is far below the developed counties.

4. The development of green building promoted by housing industrialization

4.1 Comparison of energy consumption between industrialization and conventional construction

Industry construction of the building parts is concentrated to the factory assembly line production. The use of production lines can save the labor and the construction waste discharge, and reduce the energy consumption of building. According to statistics, the use of industrial construction compared with the traditional construction, saves electricity 31%^[5], reduce construction waste 2 t / 100 m². Table 2 is the residential energy consumption comparison for adopting industrial construction and traditional construction in 2013 by Vanke Research Center. Seeing from the data, housing industrialization can reduce the amount of garbage emissions, and can reduce resource consumption and energy consumption, and reduce environmental pollution effectively. In addition, the industrialized building can improve the construction efficiency and shorten the construction period by streamline construction.

Table 1 relevant policy documents on housing industrialization

year	file name	publishing department
1996	<<Housing industrialization modernization pilot work outline>>	MOC
1999	<<Several opinions on promoting modernization of housing Industry and improving quality of housing>>	General Office of the State Council
1999	<<Notice on backward product eliminating>>	MOC
2002	<<Notice on issuing enforcement regulation on commodity House decoration once in place>>	MOC
2003	<<Regulation on selecting residential products by national Comfortable housing demonstration project>>	MOC
2004	<<Construction technology policy guidelines>>	MOC
2005	<<Guidance on developing energy and land saving houses And public buildings>>	MOC
2005	<<Several opinions on expediting reform and development Of construction industry>>	MOC
2006	<<Opinions on further strengthening building technology Updating work>>	MOC
2006	<<Notice on promoting residential department product certification>>	MOC
2006	<<Notice on issuing the trial measures for national housing Industrialization base>>	MOC
2010	<<Notice on issuing CSI residential construction technical Guidance on a trial basis>>	MOC

4.2 How to promote the development of green building

Housing industrialization by changing the building construction process, updating the construction technology to get achieve the aim of energy conservation and emissions reduction, and low-carbon environmental protection. Housing industrialization is one of the ways to promote the development of green building in China, and also the most effective way. In recent years, the government issued a large number of relevant policies to encourage construction organization to adopt the way of industrialization to construct. However, the effect is not obvious and the proportion of industrialization construction in China is far lower than the developed countries. Adopting the way of housing industrialization to drive the development of green building in China still needs to make various efforts.

Increase the propaganda promotion; promote the development of housing industrialization; take the green building road with low-carbon, environmental protection and sustainability. The effect of the development of the green building is obvious, but the occupancy rate is too low, and still cannot reach the target effect. Government should intensify publicity, launch a more attractive policy to ensure that construction organization to join the camp of the industrialization of residential construction and increase the rate of housing industrialization to promote the occupancy rate of green building.

Table 2 Comparison of energy consumption between industrialization and conventional construction

Statistical items	Industrialization	Traditional	Saving
Energy consumption per square meter (Kilogram standard coal / square meter)	17	19.11	11%
Water consumption per square meter (Cubic meters / Square meters)	1.2	1.5	20%
Water consumption per square meter (Cubic meters / Square meters)	0.004	0.005	20%
Garbage producing per square meter (Kg/square meter)	40	50	20%

Note: table 2 data is collected from Vanke Building Research in 2013.

Apply the mode of industrialization residence to public buildings. At present, the building adopting industrialization mode construction in China is mainly residence; while in foreign countries, construction of industrialization has been applied to public buildings such as school and office building. If construction of industrialization can be applied to public buildings in China, it will

increase the number of green buildings in our country, thereby promoting the development of green buildings.

Learn from the experience of foreign industrial development, as well as the advanced component producing technology and perfect component standard to reduce the energy consumption of industrialization residence. The development of foreign industrialization residence is more mature, and it not only has the perfect industrialization technology system and standard, but also the component using by industrialization building has corresponding standards and mature technologies. So that strictly control from materials to improve the construction quality, extend the service life and reduce the building total energy consumption.

5. Conclusion

At present, because of the extensive economic policy, China's building energy consumption per unit area is much higher than the developed countries'. After putting forward green city, building enterprises response positively and start to go the road of low carbon and green building. Housing industrialization is one of the ways to develop green building, and the effect is more obvious. Industrialization construction has the remarkable effect of saving materials, improving the quality of construction, reducing the labor consumption and reducing building energy consumption. To promote the development of housing industrialization is the effective way to promote the development of green building in China.

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