Cost Analysis Between Prefabricated Buildings and Traditional Buildings

Shu Wang¹, Hengchun Zhang¹, Chan Wang¹, Yuanyuan Wu¹
¹China Construction Commercial Concrete Co., Ltd. Wuhan 430074, Hubei Province, China

*Corresponding author e-mail: 787339963@qq.com

Abstract: This paper analyzes the cost between prefabricated buildings and traditional buildings with examples, compares the cost difference between prefabricated buildings and traditional buildings, and analyzes the reasons for the cost difference, so as to provide a basis for its development.

1. Introduction

Prefabricated building has become the development trend of the construction industry and is an effective way to transform the construction industry. In recent years, China's state council, various ministries and commissions have issued national policies on the development of prefabricated buildings and intensified promotion of prefabricated concrete construction unceasingly, and formulated the goal: in about 10 years, the prefabricated buildings account for 30% of new buildings. During this period, the proportion of prefabricated buildings in newly built buildings in China shall reach over 15% by 2020, including over 20% in key promotion areas, over 15% in active promotion areas and over 10% in encouraged promotion areas. However, the development of prefabricated architecture in China is still in the initial stage, with high cost and low popularization, and there is still a certain distance from the realization of the target.

This paper analyzes the cost of prefabricated buildings and traditional buildings with examples, compares the cost difference between prefabricated buildings and traditional buildings, and analyzes the reasons for the cost difference, so as to provide a basis for its development.

2. Analysis of advantages and constraints of prefabricated buildings

2.1 Advantages of prefabricated building development

Compared with traditional buildings, prefabricated buildings have the advantages of convenient construction, high construction efficiency, high quality of prefabricated components, high safety, as well as saving labor and construction costs.

2.1.1 Convenient construction and high construction efficiency

Prefabricated building can make components at the site assembly installation according to the requirements of the site, reducing the workload and the amount of wet work on the site, having convenient construction and short construction period, saving manpower and material resources, with
nail, paste and other excellent performance. In addition, fabricated building components are manufactured in the factory floor and are not affected by bad weather.

2.1.2 High quality of prefabricated components
   Prefabricated components are the foundation of prefabricated buildings, and their quality directly affects the final quality of prefabricated buildings. The various construction components of the assembly building are standardized production and pre-distribution in the production place, which can strictly control the production environment conditions, such as temperature and air humidity, so that the quality of the components can be guaranteed.

2.1.3 High security
   Traditional construction projects all need to work in the open air condition, the construction environment is often relatively bad, the construction personnel often face greater security risk. The components of prefabricated buildings can be produced and pre-allocated in advance, and professional construction personnel only need to install the components according to the standard process, so they can effectively avoid the safety hidden danger caused by open-air operation, and provide guarantee for the personal safety of construction personnel.

2.1.4 Save labor and construction costs
   On one hand, traditional construction site requires a large number of workers to work on the site, while the prefabricated building focuses on the mechanization operation, which requires only the component pre-allocation in the factory and the site assembly by a small number of professional construction personnel and saves the labor cost. On the other hand, the traditional pouring construction method requires a large number of temporary construction devices such as scaffolding, support and formwork to be set up on the construction site, which cannot be recycled after being removed. However, prefabricated construction saves this part of cost.

2.2 constraints on the development of prefabricated buildings
   In view of the above advantages of prefabricated buildings, the state has issued policies to vigorously promote the development of prefabricated buildings. However, due to the late start of the development of prefabricated buildings in China, the market environment and technology are not mature, which restrict the development of prefabricated buildings.

2.2.1 The market chain is not coordinated
   At present, the enterprises in the links of scientific research, investment development, design, production and manufacturing, construction and hoisting on the chain of prefabricated houses are still dependent on the production mode of traditional buildings. Each link lacks effective connection and coordination between each other. The production organization system lacks effective integration and the transaction cost is high.

2.2.2 Policy implementation is not in place
   Although the state has issued policies to encourage the construction of prefabricated buildings, the specific implementation rules are not perfect, the local government is not in place, it lacks organizational mechanism for enterprises, and it did not actively guide the transformation of the original enterprises and establish a cultivation mechanism for enterprises.

2.2.3 Imperfect management system
   At present, the supervision mechanism for project bidding, construction permit, review of construction drawings, quality inspection and completion acceptance, which are suitable for the promotion of prefabricated buildings, lags behind. And this will cause the uncertainty of the construction process of prefabricated buildings to a large extent.

2.2.4 Incomplete supporting standards
   At present, there is no supporting standard technical system in the whole process of prefabricated construction. There are no perfect construction standards and unified quality acceptance standards for the industrialization of assembly construction projects, parts production standards and relevant
supporting parts production acceptance.

2.2.5 Immature technology

The development of prefabricated buildings must be based on advanced technology. But at present, the whole industrial chain of prefabricated buildings is lack of key technologies and the system integration is low. The key technologies and methods of integrated and standardized design of prefabricated buildings are lagging behind, and the problems of disconnection between design, processing, production, construction and assembly are widespread.

2.3 Influence of advantages and disadvantages of prefabricated buildings on their costs

Many restrictive factors of prefabricated construction will affect the cost of prefabricated construction projects. Discordance of market chain, cause trade cost increasing. The lack of policies, regulations, systems and standards causes the increase of management costs. The technology is not mature, requiring higher design and construction standards, more stringent raw material grade, construction process requirements, and thus leading to an increase in costs.

Prefabricated buildings has advantages and disadvantages on the cost. This research report analyzes the cost difference between prefabricated buildings and traditional buildings based on specific engineering examples.

3. Cost analysis of prefabricated construction engineering and traditional construction engineering

3.1 Cost composition of construction project

Housing construction cost is divided into construction engineering cost, building installation cost and building decoration cost. Construction project cost refers to the investment in the construction of housing. It is the foundation project, main structure, walls, doors and windows of the building part, the strong and weak electricity of hydropower projects, as well as the material and labor cost input such as water supply and drainage. Installation cost is the input to install the facilities and equipment of the house. Architectural decoration project refers to the beautification project after the main body of building is completed.

3.2 sample project cost analysis

3.2.1 Basic information of the sample project

This report selects a case of assembly construction engineering and traditional construction engineering, and the specific parameters are shown in Table 1.[1]

| Number | Type            | Construction area (m²) | Number of floors | Floor height | Structure type                  | Assembly rate |
|--------|-----------------|------------------------|------------------|--------------|---------------------------------|---------------|
| 1      | Prefabricated building | 10532                  | 23               | 2.9          | The vertical load-bearing column wall adopts cast-in-place reinforced concrete. The rest beam plates and inner and outer protective walls adopt prefabricated reinforced concrete structure | 48.6%         |
| 2      | Traditional building      | 13400                  | 18               | 2.9          | Frame shear wall structure       | /             |

Due to the differences between the structure of prefabricated construction engineering and traditional construction engineering, the consumption of concrete index, reinforcement index, brick masonry index, interior wall plastering index, ceiling powder ash, formwork, exterior wall stucco base
is different. The specific resource consumption of each indicator of the two sample projects is shown in Table 2. As shown in Table 2, the consumption of concrete and steel on prefabricated buildings are higher than those of traditional construction projects, which is about 14%. But the interior wall plastering and formwork indexes of prefabricated buildings are lower than that of traditional construction engineering.

**Table 2** Comparison of resource consumption index between prefabricated construction engineering and traditional construction engineering

| Number | Name                          | Prefabricated building | Traditional building | Difference |
|--------|-------------------------------|------------------------|----------------------|------------|
| 1      | Concrete (m³/m²)             | 0.42                   | 0.36                 | 0.06       |
| 2      | Rebar (kg/m³)                | 46.96                  | 40.35                | 6.61       |
| 3      | Brick masonry (m³/m²)        | 0.04                   | 0.14                 | -0.10      |
| 4      | Wall plaster (m³/m²)         | 0.39                   | 1.84                 | -1.45      |
| 5      | Ceiling blues (m³/m²)        | 0                      | 0.93                 | -0.93      |
| 6      | Template (m³/m²)             | 1.12                   | 3.36                 | -2.24      |
| 7      | Exterior paint base (m³/m²)  | 0                      | 0.83                 | -0.83      |

*Note: the indicators in the table refer to the consumption of resources under the condition of the same floor area.*

3.2.2 Cost comparison between prefabricated construction engineering and traditional construction engineering

Based on the "Prefabricated consumption quota and full cost base price table of Hubei province" and "Consumption quota and full cost base price table of housing construction and decoration project in Hubei province", the cost data of the two types of buildings are shown in Table 3.

**Table 3** Cost analysis of prefabricated construction engineering and traditional construction engineering (Yuan per square meter)

| Type               | Prefabricated construction engineering | Traditional construction engineering | Difference |
|--------------------|----------------------------------------|--------------------------------------|------------|
| Construction engineering | 792.45 | 1008.64 | 360.27 |
|                     | 576.46 |            |          |
| Building decoration | 275.29 | 307.79 | -32.5  |
| Building installation | 221.31 | 224.29 | -2.98  |
| Total              | 1865.5 | 1540.72 | 324.78 |

In terms of building structure, the prefabricated structure cost is 1338.91 yuan/m², 32.7% higher than the 1008.64 yuan/m² of traditional construction.

In terms of decoration engineering, the prefabricated building decoration engineering cost is 275.297 yuan/m², 11.8% lower than the 307.79 yuan/m² of the traditional construction engineering cost.

In terms of installation engineering, the cost of prefabricated building installation engineering is 1.34% lower than that of traditional construction engineering. Therefore, they are basically flat compared with traditional construction engineering.
To sum up, the price of prefabricated construction project is 324.78 yuan/m², which are 21% higher than that of traditional construction project. The cost difference between prefabricated construction and traditional construction mainly comes from precast concrete components.

3.2.3 Reason analysis of high prefabricated construction cost

Through investigation and analysis, the code requirements of prefabricated construction engineering are higher, resulting in higher input level of resources and higher consumption. Therefore, the cost of building materials and precast concrete components is higher.

(1) Prefabricated concrete structures are made of laminated slabs, with a total thickness thicker than the traditional floor. Generally speaking, the thickness of precast concrete slab is 8cm, and the as-cast slab is 6cm, which is at least 2cm thicker than the ordinary floor, and the cost difference is about 16 yuan/m². In addition, the content of concrete and steel in prefabricated buildings is 0.06 m³/m² and 6.61 kg/m², respectively, higher than that in traditional construction projects (Table 2), which results the in costs increasing.

(2) Precast reinforced concrete partition panels are used for prefabricated construction project partitions, while hollow brick blocks are used for shear wall partitions in traditional buildings. The price of Prefabricated diaphragm wall for prefabricated construction is about 2,236.13 yuan/m³. Traditional buildings are built with a1-10 hollow brick walls. The quota of direct material cost is 771 yuan/m³, and indirect material cost of dry mixing mortar, water and other materials is less than 400 yuan/m³. Taking the masonry of traditional construction projects as an example, the wall difference is 0.15* (2236.13-771-400) =159.75 yuan/m².

(3) The price of precast concrete components for prefabricated construction engineering is about 2,500 yuan / m³, while the price of cast-in-place concrete is about 2,000 yuan / m³. The difference is 500 yuan / m³.

3.3 Analysis of subsidy policies of various provinces and cities

China's prefabricated building is in the development of the primary stage. The supporting is immature and the price is high. In order to promote the development of prefabricated buildings, the state and provinces have introduced corresponding incentive and subsidy policies.

The incentive policies of various provinces and cities include: land use support, financial subsidy, special fund, tax and fee preference, plot ratio, appraisal and award, credit support, examination and approval, consumption guidance, industry support and other 10 categories. At present, 31 provinces have issued relevant incentive policies, with an average of 4 incentive policies. Xinjiang has the largest number of items, which is 8.

According to the policy introduced by the provinces, the national preferential policy is equivalent to about 300 yuan/square meter discount for prefabricated buildings. For the construction side, although the prefabricated construction project cost is higher than the traditional construction project, but the country gives the policy preference, can make the two basically equal.

4. Conclusions

Compared with traditional building, prefabricated building construction is convenient, high construction efficiency, prefabricated high quality, high safety and saving manpower, construction cost advantages, has obvious economic and social benefits, so the state has staged a series of supporting policies promote the development of prefabricated construction. but as prefabricated construction development in our country starts late, the market chain is not coordination, policy implementation does not reach the designated position, management system is imperfect, the complete set of standards is not sound, the technology is immature, the development of refabricated building is restricted.

The advantages and disadvantages of prefabricated buildings have a dual impact on their costs. According to the calculation of examples in this paper, the cost of prefabricated construction projects in China is higher than that of traditional construction projects, mainly because of higher requirements on the code of prefabricated construction projects, resulting in higher input level of resources, higher consumption, and higher cost of construction materials and precast concrete components.
In addition, according to relevant reports, the price of prefabricated construction projects is about 250-500 yuan/m² higher than that of traditional construction projects(source: China real estate news interview with zhao tian, President of China architecture design and research institute, guangzhou daily, etc.). And a series of preferential policies introduced by provinces and cities in China bring about 300 yuan/square meters of preferential, for the construction side, which can basically eliminate the cost difference between prefabricated buildings and traditional construction projects.

Reference
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