World Scientific Research Journal (WSRJ) ISSN: 2472-3703
www.wsr-j.org

Comparative Study on Cost of Fabricated Construction and Traditional Construction Projects

Yuyan Bai [a], Jianbo Zheng [b, *]

Binzhou University, Binzhou, 256600, China

[a]757054034 @qq.com, [b]zjb2006@163.com

Abstract: On the basis of typical engineering cases, the cost and unidirectional indexes of the assembly and traditional construction are compared and analyzed, and the reasonable suggestions for the design and construction are put forward.
Keywords: fabricated construction; traditional construction; cost.

---

1. INTRODUCTION

In recent years, with the strong support of the State Construction Department, the assembly construction project began to develop rapidly. The assembly type construction project mainly refers to the project that the precast component is prefabricated in the factory and then transported to the construction site. The birth and rise of assembly architecture is the innovation and continuation of construction means such as site production and installation, which is represented by cast-in-place construction operations. It is also the embodiment of the gradual promotion of the current level of industrialization in the construction industry [1]. However, at present, the contradiction between the high cost of the assembly construction project and the construction advantage and its own cost has been restricting the healthy development of the assembly construction project in China.

In this context, in order to further understand the cost of the assembly construction project and the traditional cast-in-place construction, and to solve the current factors that restrict the development of the assembly construction project, it lays the foundation for the compilation of the assembly construction engineering department and the revision of the assembly type quota valuation basis and can further maintain the assembly construction engineering market. Order and promote the healthy development of the fabricated building market and provide effective reference.

2. CASE ANALYSIS

2.1 Selection of typical engineering

The selection of typical projects needs to consider the representativeness of projects. The typical project should be selected to fully reflect the characteristics of the project, the consumption of the material machine and the construction method, and its design, construction and supervision are all in accordance with the scientific, rational and practical requirements.

In the case analysis part, because the current level of assembly construction technology is still in the groping stage, there is a general situation of low assembly rate and less assembly engineering in various construction units. Therefore, according to the actual situation, this paper selects an assembly construction project, 23 layers, the building area of 10532 m^2, the vertical load-bearing column wall with cast-in-place reinforced concrete, the rest of the beam plate and the inner and outer wall of the assembly type reinforced concrete structure, the assembly rate is 48.6%. [2, 3]

The traditional building selects a residential building in Changsha (hereinafter referred to as the traditional building), which is 18 story, frame shear wall structure with a floor area of 13400 m2. The following is a list of the characteristics of the two projects.

Table 1. Project features

Project features	Assembly building	Traditional architecture
Number of layers	23	18
House type	Two ladder and four households	Two ladder and four households
Eaves height (m)	68.2	53.85
Layer height (m)	2.9	2.9
Architectural area(m^2)	10532	13400

As can be seen from the above table, the two items selected are similar in the characteristics of the project, and the two items are all in Changsha, which can effectively eliminate the errors caused by different regions and lay the foundation for the follow-up study of this article.

2.2 Comparison of individual indexes between fabricated building and traditional buildings

The difference between the fabricated building and the traditional buildings is analyzed. The main indicators are: concrete index, Steel bar index, brick masonry, interior wall plastering index, ceiling powder ash, template, exterior wall brush base, tower crane class. In terms of specific meaning, the single index is mainly based on the consumption of input resources under the same construction area. [4]

Based on the above two items, according to the calculation of drawings, the following single index data are obtained, and the results are shown in table 2-2 below.

Table 2. comparison of individual indexes between fabricated and traditional buildings

Serial NO.	Entry name	Unit	Assembly building	Traditional architecture
1	concrete index	m3/m2	0.42	0.36
1.1	PC component concrete	m3/m2	0.2	0.36
1.2	Cast-in-place concrete	m3/m2	0.22	
2	Steel bar index	kg/m2	46.96	40.35
2.1	PC member steel bar	kg/m2	22.21	40.35
2.2	Cast-in-place steel bar	kg/m2	24.75	
3	Brick masonry	m3/m2	0.04	0.14
4	Interior wall plastering index	m3/m2	0.39	1.84
5	Ceiling plastering	m3/m2	0	0.93
6	Template	m3/m2	1.12	3.36
7	The exterior wall paint base	m3/m2	0	0.828
8	Tower crane	machine-team	9.029	9.029

As can be seen from the above table, the concrete index of the fabricated building is higher than that of the traditional building, and the steel bar index is higher than the traditional building, which is 14.07% higher than that of the traditional building. Correspondingly, brick masonry, interior wall plastering and formwork are much lower than traditional building indexes. This is in line with the characteristics of fabricated buildings and traditional buildings, and also accords with the relevant requirements of the current construction technology of fabricated construction projects. It is also further explained that, in the same situation, although the amount of reinforced concrete is slightly higher than the traditional building, the existence of prefabricated components makes the brick masonry, the interior wall plastering, the ceiling plastering and the formwork greatly reduced.

2.3 Comparison and analysis of cost indices between fabricated and traditional construction projects

2.3.1 Comparison and analysis of cost data of building structure engineering

Through the comparison of the above single index, it is found that the amount of construction area per square meter of assembled building concrete and steel bar is slightly higher than that of traditional architecture, but other indexes are far lower than that of traditional buildings. In terms of specific cost comparison, this paper calculates the following cost data based on the Hunan provincial assembly trial quota and the traditional quota [5]. The following is a comparative analysis of cost data for building structural engineering. The results are shown in table 2-3 as follows:

Table 3. Comparison of cost data of building structure engineering

Serial NO.	Project	Unit(RMB)	Assembly building	traditional architecture	Difference value
1	Part of architectural structure	yuan/m^2	1368.9	1008.64	360.26
1.1	Assembly price	yuan/m^2	792.45	1008.64	/
1.2	Cast in place price	yuan/m^2	576.46		/

The above contrast ranges include structural parts and wall base plastering, such as concrete, masonry, reinforcing bars, formwork, roofing and so on. Through the comparison, it is found that the cost of the fabricated structure is 26.31% higher than that of the traditional structure. This situation is mainly caused by the following reasons: first, the assembly construction technology is still in the exploratory stage, and the construction technology is immature. Secondly, the specifications of prefabricated components are higher and the consumption of main resources is greater. Third, the price of prefabricated components is very expensive at present.

2.3.2 Comparison and analysis of the cost data of decoration engineering

In the decoration engineering, compared with two projects, it is found that the cost of the assembly building decoration project is 275.29 yuan/m2, compared with the traditional construction cost of 307.79 yuan/m2 and 11.8%. The following is a part of the decoration project. After a lot of calculation, the comparison of the cost data shown in table 2-4 is as follows:

Table 4. comparison of cost data for decoration engineering

Serial number	Project	Unit(RMB)	Assembly building Assembly rate 48.6%	Traditional architecture	Difference value
1	Ornamental part	yuan/m^2	275.29	307.79	-32.5
2	Construction and installation cost	yuan/m^2	275.29	307.79	-32.5
2.1	Construction and installation cost of decoration part	yuan/m^2	247.12	276.29	-29.17
2.2	Decorative part sales tax	yuan/m^2	27.12	30.39	-3.21
2.3	Additional tax and fee for the decoration part	yuan/m^2	0.99	1.1	0.11

From the above table, it can be seen from the above table that the installation construction project decoration project construction safety cost is 275.29 yuan/m2, of which the decoration part of construction and installation cost, the assembly building is lower than the traditional building 11.8%.

2.3.3 Comparison and analysis of the cost data of installation engineering

In terms of installation engineering, compared with the two projects, it is found that the cost of fabricated building installation works is lower than the traditional construction cost of 1.34%. Overall, in terms of installation works, fabricated buildings are basically slightly higher than traditional ones. The details are shown in table 2-5 below.

Table 5. comparison of cost data for installation engineering

Serial number	project	Unit (RMB)	Assembly building Assembly rate 48.6%	traditional architecture	Difference value
1	Installation part	yuan/m^2	221.31	224.29	-2.98
1.1	Water supply and drainage	yuan/m^2	51.81	50.82	0.99
1.2	Strong electricity	yuan/m^2	78.89	82.44	-3.55
1.3	Weak current	yuan/m^2	37.53	38.08	-0.55
1.4	Fire control	yuan/m^2	13.08	12.96	0.12
1.5	Elevator12.06	yuan/m^2	40	40	0

2.3.4 Comparison and analysis of construction cost data

Compared with the cost data of construction engineering, decoration engineering and installation engineering, it is found that the cost of the construction engineering of the assembly construction project is 1368.9 yuan/m^2, which is 26.31% higher than that of the traditional building 1008.64 yuan/m^2. The cost of decoration engineering for fabricated construction works is 275.29 yuan/m^2, which is 11.8% lower than that of the traditional building 307.79. The cost of fabricated installation is 221.31 yuan/m^2, which is 1.34% lower than that of the traditional building 224.29 yuan/m^2. The final cost reduction results show that the cost of the fabricated construction project is 1865.51 yuan/m^2, which is 17.18% higher than that of the traditional building 1545 yuan/m^2.

2.4 Cause analysis of cost difference between fabricated construction project and traditional construction project

2.4.1 Structural differences

The traditional shear wall structure, the partition wall uses the hollow brick block. However, precast concrete partitions are used in fabricated concrete structures. The traditional shear wall structure adopts the cast-in-place structure, while the PC structure of the fabricated construction project adopts the composite slab, the total thickness is thicker than the traditional floor. The concrete structure of the fabricated construction project needs to be grouted, while the traditional shear wall structure does not need it. [6].

2.4.2 The reasons for the high cost of the assembly construction project

(1) The material grade is high: the partition wall plate instead of brick wall is expensive, for example, the masonry 0.15 m^3/m^2 of the traditional construction project is compared and calculated, the A4-23 thick 190mm quota is directly charged 405 yuan/m^3, and the cost is not more than 800 yuan/m^3. The assembly construction concrete structure wall material is

averaging 2410 yuan/m^3, both at least 1601 yuan/m^3, so the wall is poor. The difference should be 0.15×1601=240.15 element/m^2.

(2) The amount of material is more: the assembly type building floor uses the laminated plate. The thickness of the assembly construction project PC plate is 6cm, and the cast in place plate is 8cm, which is at least 2cm and 16 yuan/m^2 worse than the ordinary floor. In addition, the content of the assembled building concrete and steel is 0.06 m^3/m^2 and 0.10 m^3/m^2 higher than that of the traditional building.

(3) The average price of the PC component of the fabricated construction project is 2500 yuan/m^3, which is 2000 yuan higher than the cast-in-place concrete price and 500 yuan/m^3 higher than the PC component.

(4) According to the field investigation, it is found that the construction of precast lifting and pouring of cast-in-place members is not a time saving project. In addition, due to the immature construction technology, the tightness of cast-in-place and hoisting is not high enough, resulting in less effective construction period and cost increase.

3. SUGGESTIONS AND THINKING

The assembly architecture has appeared in China in the 80s of last century, but after decades of development, it has been flat, the main constraint is the high cost, so the implementation of the assembly building to reach 30% of the market share, it should be based on reducing the cost as a breadth.

3.1 Technical improvement

The implementation of fabricated buildings can be seen as a breakthrough in reducing the cost of construction from technical improvements. Adopting a scientific and reasonable design plan can indirectly increase the added value of fabricated buildings, thereby reducing the cost of construction. Therefore, the design can be optimized from the combination of modulus, standardization, use function, cast-in-place and prefabrication. [5, 7]

3.1.1 Design optimization

(1) To increase assembly rate, columns, walls, interior walls and floors can be prefabricated to reduce costs.

(2) High strength concrete and steel bar can be used in the structural part to reduce material consumption.

(3) The main structure, interior decoration, water and electricity installation and so on can be industrialized integrated technology.

(4) Building envelopes, balconies, staircases, air conditioning panels, doors and windows and other components can be industrialized.

(5) External wall decoration can take durable and once formed construction materials.

(6) Optimize the waterproof design, that is, to achieve the beautiful appearance effect, and cannot affect the external wall waterproofing.

(7) Popularize the application of building information model (BIM) technology in the process of assembly building and realize the whole life cycle data sharing and information management of the assembly construction project.

3. 1. 2 Optimization of production and construction

(1) Improve the production process of prefabricated components, improve the efficiency of modular utilization, and reduce the amortization cost of manufacturers.

(2) Optimize the installation process of prefabricated components, improve the efficiency of workers and machines, and reduce their consumption.

3.2 Standardizing market competition and government support

3.2.1 Standardizing market competition

It is of great practical significance to strengthen the price supervision of the relevant administrative units for prefabricated component manufacturers, so as to popularize the fabricated buildings and regulate the market competition. First of all, precast components account for most of the cost of fabricated buildings. Secondly, there are few prefabricated component manufacturers in the prefabricated construction industry, and price monopoly is more common [8]. If allowed prices remain high, it will seriously affect the healthy development of the fabricated building industry.

3.2.2 Strengthening the support of the government

At present, the high cost of assembly building is a widely accepted fact. In the next ten years, the proportion of the assembly building in the new building area is 30%. Reducing the cost is the key problem that must be solved first, and for the three aspects of the construction party, Party A and the government, the government should take the lead to increase support, increase subsidies and reduce taxes.

4. CONCLUSION AND PROSPECT

With the increasing perfection of the socialist market economy system in China and the continuous emergence of new technology, new technology and new materials in the assembly building industry, the study of the cost difference between the assembly architecture and the traditional architecture has played an important role in the future development of the entire assembly building industry. At present, the assembly construction project is still in the embryonic stage of development. How to revise the pricing basis which conforms to the actual situation of the market is closely related to the standard development of the entire assembly building industry. In this context, it is urgent to analyze the cost of the assembly construction project compared to the traditional construction project and provide a powerful reference for the cost management department to revise the valuation basis.

Through the case analysis, it is found that the cost of the assembly construction project is 17.18% higher than that of the traditional project. In the aspect of building structure engineering, compared with the traditional construction project, the cost of the assembly construction project is 380.01 yuan/m^2 higher than that of the traditional construction project; In terms of decoration engineering, it is found that the cost of fabricated construction is 53.92 yuan/m^2 lower than that

of traditional construction projects; In terms of installation works, it is found that the cost of fabricated construction is 3.54 yuan/m^2 lower than that of traditional construction projects.

To sum up, the cost of PC housing per flat meter will be reduced substantially in 3~5 years, the cost of PC housing can be equal to or slightly lower than that of traditional housing. In the foreseeable future, the cost of PC housing will be lower than the traditional house cost, and the quality is higher. If you can take the hardcover route, the advantages will be more obvious.

ACKNOWLEDGEMENTS

The financial support from the Key Project of Experimental Technology of Binzhou University (NO. BZXYSYXM201705), and from the National College Students' Innovation and Entrepreneurship Training Project (NO.201710449078).

REFERENCES

[1] Wang Hui. Analysis and Research on the cost of prefabricated building [J]. Science & Technology Economy Market, 2017(11): 94-97.

[2] Zhang Chengcheng, Liu Chunmei, Zhao Yongsheng. Analysis of the factors affecting the construction cost of industrial buildings [J]. Journal of Liaocheng University (Natural Science Edition), 2015(4):64-68.

[3] Zhu Fatong. Study on the influence of construction industrialization on project cost [D]. Guangzhou University, Guangzhou, 2016.

[4] Shi Weiguo. Research on project cost management of assembly building enterprise [D]. Soochow University, Suzhou, 2016.

[5] Li Ying. Cost analysis of assembly integrated building based on value chain model [J]. China Management Informationization, 2016(7):10-14.

[6] Gu Xiaoying, Zhang Rui, Zhao Weimin, Yang Xia. Analysis on the cost and control measures of assembled monolithic concrete buildings [J]. Construction Science and Technology, 2017(10):66-68.

[7] Lu Yao. Application and cost analysis of precast concrete building [J]. Modern Economic Information, 2015(12):112.

[8] Wu Rui. Cost benefit analysis of residential project development under assembly mode [D]. Xihua University, Chengdu, 2017.