

The Application of Traditional Chinese Wood Frame Construction Technology in Modern Architectural Design

Yongliang Bai

Liaoning Communication University, Shenyang, 110000, Liaoning, China

Keywords: Traditional wooden frame; Modern architectural design; Building technology

Abstract: Traditional wooden frame construction technology is an important part of the ancient architectural history of China, which has unique aesthetic and practical value. It is of great value and potential to apply China traditional wooden frame construction technology to modern architectural design. However, with the rapid development of modern society, the application of traditional wooden frame construction technology in modern architectural design is gradually decreasing, facing the challenge of inheritance and development. Firstly, this paper introduces the history and characteristics of traditional wooden frame construction technology, and expounds its importance and significance in modern architectural design. Subsequently, in view of the challenges and limitations faced by the traditional wooden frame construction technology in modern application, this paper makes in-depth discussion from the aspects of technology, cost, construction period, regional and cultural differences and intellectual property protection, and puts forward a series of effective solutions.

1. Introduction

With the rapid development of society and the continuous innovation of technology, modern architectural design often ignores the importance of historical traditions and regional characteristics while pursuing innovation and practicality[1]. The traditional wooden frame construction technology in China has a long history, which embodies thousands of years of wisdom and artistic achievements. This architectural system, which is dominated by wood structure and supplemented by other materials such as stone and earth, has become a unique landscape in the history of ancient architecture in China with its exquisite structural design, flexible spatial layout and unique aesthetic style[2]. Traditional wooden frame buildings connect beams and columns with tenon-mortise structure to form the skeleton of the house, and then different materials are used as the enclosure structure, which fully shows the wisdom and skills of ancient China people[3].

As a treasure in the world's architectural treasure house, China's traditional wooden frame construction technology has irreplaceable historical and cultural value. It has many advantages to apply traditional wooden frame construction technology to modern architectural design. First of all, environmental protection is sustainable[4]. As a renewable resource, the wood used in traditional wooden frame buildings has the characteristics of low carbon, environmental protection and sustainability, which is in line with the current background of green development. Secondly, it is rich in cultural value. Traditional wooden frame architecture technology contains a lot of cultural information, such as regional characteristics and national culture. Integrating these elements into modern architectural design will undoubtedly enhance the cultural connotation and characteristics of architecture[5]. In addition, the traditional wooden frame building also has the characteristics of flexible space and superior seismic performance, which provides a new idea for modern architectural design. However, the application of traditional wooden frame construction technology to modern architectural design also faces some challenges and limitations. The traditional wood frame construction technology is highly dependent on wood, but the shortage of wood resources is becoming more and more serious[6]. Therefore, how to achieve the balance between sustainable development and resource utilization on the basis of ensuring traditional technology is an important problem to be solved at present.

It is of great value and potential to apply China traditional wooden frame construction

technology to modern architectural design. Through in-depth excavation and study of the essence of traditional crafts, combined with modern technology and demand for innovative application, we can not only create unique modern architectural works, but also contribute to the inheritance and development of Chinese traditional culture. This paper will analyze the application of China traditional wooden frame construction technology in modern architectural design from different angles, in order to provide some valuable reference for related fields.

2. Brief introduction of traditional wooden frame construction technology in China

2.1. Origin and history

The traditional wooden frame construction technology in China originated from ancient times, gradually developed and matured, and was widely used in architectural practice in various parts of China. This kind of building system is mainly made of wood structure, which uses tenons and mortises to connect beams and columns to form the frame structure of the house, and then uses other materials as the enclosure structure to construct a unique architectural space.

2.2. Main feature

(1) Wood structure: Traditional wood frame buildings mainly use hardwood as main materials, such as pine and cypress, which have durability and good mechanical properties. Through precise processing and connection, a stable wooden frame is formed.

(2) Tenon and mortise structure: tenon and mortise are two different connection modes, and they can bear a large load through accurate design and manufacture. This structural form not only has high stability, but also has extremely high seismic performance.

(3) Spatial flexibility: The spatial layout of traditional wooden frame buildings is very flexible, and the size and shape of rooms can be changed as needed. This flexibility provides architects with more creative space.

(4) Rich cultural connotation: Traditional wooden frame architecture is not only a practical architectural form, but also carries a lot of cultural information. The forms, materials and decorations of buildings all reflect the cultural traditions and characteristics of different regions and nationalities.

2.3. Development situation

Although the traditional wooden frame construction technology has been challenged in modern society, its unique architectural charm and cultural value are still widely recognized. In modern architectural design, more and more architects began to try to combine traditional wooden frame architectural elements with modern architectural design to create modern architectural works with historical sense and cultural characteristics. At the same time, with the progress of technology and the emergence of new materials, the traditional wooden frame construction technology has also been continuously improved and innovated to meet the needs of modern society for architectural functions and aesthetics.

3. Advantages of traditional wooden frame construction technology in modern architectural design

(1) Environmental protection and sustainability

The wood used in traditional wooden frame buildings is a renewable resource with the advantages of low carbon, environmental protection and sustainability. Compared with concrete and steel widely used in modern buildings, wood has lower carbon emissions and better environmental adaptability. In addition, with the continuous development of modern science and technology, new wooden buildings are becoming more and more popular. These buildings have higher strength and durability, and are more environmentally friendly.

(2) Rich cultural value

Traditional wooden frame architecture is an important part of ancient culture in China, with rich

cultural connotations and characteristics. The application of traditional wooden frame construction technology in modern architectural design can not only carry forward and inherit the traditional culture of China, but also enhance the cultural value and characteristics of the building. For example, in a modern commercial building, the traditional wooden frame building is used for decoration, which makes the whole building both modern and traditional.

(3) High flexibility

The spatial layout of traditional wooden frame buildings is very flexible, which can be transformed and expanded according to different needs. This flexibility provides more creative space for modern architects, and can better realize personalized and customized architectural design. For example, in the design of a modern residence, the traditional wooden frame building is used for space layout, which makes the living space more practical, comfortable and warm.

(4) Good energy saving.

The traditional wooden frame building has good thermal insulation and ventilation performance, which can effectively reduce the energy consumption and maintenance cost of the building. Compared with modern buildings, traditional wooden frame buildings are more energy-saving and environmentally friendly, which conforms to the current development trend of green buildings. For example, in a modern commercial complex, the traditional wooden frame building is used for thermal insulation and ventilation design, which effectively reduces the energy consumption and maintenance cost of the building. Table 1 summarizes the advantages of traditional wooden frame construction technology in modern architectural design:

Table 1 Advantages of traditional wooden frame construction technology in modern architectural design

Superiority	Describe
Environmental protection and sustainability	The wood used in traditional wooden frame buildings is a renewable resource with the advantages of low carbon, environmental protection and sustainability.
Rich in cultural value	Traditional wooden frame architecture is an important part of ancient culture in China, with rich cultural connotations and characteristics.
High flexibility	The spatial layout of traditional wooden frame buildings is very flexible, which can be transformed and expanded according to different needs.
High integration with modern design.	Traditional wooden frame construction technology and modern architectural design concept complement each other, and can be mutually integrated and promoted.
Excellent seismic performance	Traditional wooden frame buildings have high seismic performance and can effectively resist earthquake damage.
Sense of history and commemorative value	Traditional wooden frame architecture has a certain sense of history and commemorative value, which can add unique charm and cultural heritage to modern architectural design.

4. Application of traditional wooden frame construction technology in modern architectural design

4.1. Direct application

Direct application refers to the direct application of the form, structure, decoration and other elements of traditional wooden frame buildings to modern architectural design. This method not only retains the cultural connotation of traditional wooden frame architecture, but also reflects the inheritance and respect for history and culture. For example, in the design of a cultural exhibition hall, the forms and materials of traditional wooden frame buildings are used as the main structure, and at the same time, modern building materials and technologies are combined to create an architectural space full of historical sense and cultural atmosphere.

4.2. Modernization and reinterpretation

Modernization and reinterpretation is to modernize and reinterpret the traditional wooden frame

building on the basis of retaining its essence, so as to make it conform to modern aesthetic concepts and functional requirements[7]. This method not only retains the aesthetic value of traditional elements, but also endows modern architectural design with new creativity and characteristics. For example, in the design of a commercial complex, some elements of traditional wooden frame buildings are used and modernized to meet the needs of modern commercial space [8]. At the same time, with the help of modern technology such as 3D printing, traditional elements are combined with modern technology to create more creative and practical architectural space.

4.3. Combined with other materials and technologies

Traditional wooden frame construction technology can also be combined with other materials and technologies to complete modern architectural design. In this way, the advantages of traditional elements and other materials and technologies can be integrated with each other to form a unique architectural style. For example, in the design of a high-rise residential building, the form and structure of traditional wooden frame building are used as decorative elements, and modern building materials and construction technology are combined to enrich the form and style of the building and improve the comfort and quality of the house.

5. Challenges and limitations of traditional wooden frame construction technology in modern architectural design

5.1. Application challenge

(1) High technical difficulty

Traditional wooden frame construction technology requires superb skills and experience, and requires higher skills of workers. In modern architectural design, the requirements for details, structure and construction are more precise and strict, so a higher technical level is needed to ensure the safety and stability of the application of traditional wooden frame construction technology in modern architectural design.

(2) the cost is relatively high

Traditional wood frame construction technology needs to use a lot of high-quality wood, and the fine process of production and processing leads to relatively high cost. In modern architectural design, cost control is an important consideration, so it is necessary to balance the relationship between the application of traditional wooden frame construction technology and cost control.

(3) Long construction period

The construction period of traditional wooden frame building is long, and it needs to go through many processes and steps to complete. In contrast, the construction period of modern buildings is generally short, so it is necessary to consider the construction progress and overall plan when applying the traditional wooden frame construction technology.

5.2. Application restriction

(1) Regional and cultural differences

Traditional wooden frame construction technology is closely related to specific regions and cultures, and there are differences in wooden frame construction styles in different regions. When applying traditional wooden frame construction technology in modern architectural design, it is necessary to consider regional and cultural differences to ensure the integration of architectural works with local environment and culture.

(2) Insufficient protection of intellectual property rights

The lack of intellectual property protection of traditional wooden frame construction technology is easy to lead to infringement. Modern architectural design should pay attention to the protection of intellectual property rights, so as to avoid bad competition caused by plagiarism and copying and damage the reputation of traditional wooden frame construction technology.

5.3. Coping strategies and suggestions

Combined with modern scientific and technological means such as 3D printing, it simplifies the

production and processing process, improves efficiency, and pays attention to retaining the unique charm and cultural connotation of traditional wooden frame buildings. Reasonable selection of high-quality wood and reduction of production costs, combined with modern building materials and technologies, optimize overall cost control, and realize the wide application of traditional wood frame construction technology in modern architectural design. Combined with modern construction technology, the construction method of traditional wooden frame buildings is innovated, the construction process is simplified, and the construction period is shortened to meet the rapid construction needs of modern buildings. To establish a sound intellectual property protection system, institutions should strengthen the intellectual property protection of traditional wooden frame construction technology. This includes taking severe measures to crack down on infringement, ensuring a good market order, and promoting the inheritance and development of traditional wooden frame construction technology. Table 2 summarizes the solutions to the above challenges and limitations.

Table 2 Solutions

Challenge	Solution
High technical difficulty	Improve the technical level and introduce modern scientific and technological means such as 3D printing to simplify the production and processing process.
The cost is relatively high.	Reasonable selection of high-quality wood and reduction of production cost, combined with modern building materials and technology to optimize the overall cost control.
Long construction period	Combined with modern construction technology, the construction method of traditional wooden frame building is innovated, the construction process is simplified and the construction period is shortened.
Regional and cultural differences	Pay attention to retaining the unique charm and cultural connotation of traditional wooden frame buildings, and integrate with local environment and culture.
Insufficient protection of intellectual property rights	Establish and improve the intellectual property protection system, and strengthen the intellectual property protection of traditional wooden frame construction technology.

6. Conclusions

This paper discusses the application of traditional wooden frame construction technology in modern architectural design. Through the analysis of the history, characteristics and application of traditional wooden frame construction technology in modern architectural design, we can see that traditional wooden frame construction technology has a wide application prospect and value in modern architectural design. However, there are also some challenges and limitations in practice, such as high technical difficulty, relatively high cost, long construction period, regional and cultural differences and insufficient intellectual property protection. Aiming at these problems, a series of comprehensive solutions are put forward. First of all, it is necessary to improve the technical level, simplify the production and processing process with the help of modern scientific and technological means such as 3D printing, and improve efficiency. Secondly, in cost control optimization, it is essential to reasonably select high-quality wood and reduce production costs. Thirdly, when exploring innovative construction methods, organizations should combine modern construction technology with innovative techniques for traditional wooden frame buildings. In addition, attention should be paid to retaining the unique charm and cultural connotation of traditional wooden frame buildings and integrating them with the local environment and culture. Finally, institutions should establish a sound intellectual property protection system and strengthen the intellectual property protection of traditional wooden frame construction technology.

References

- [1] Li Quan, Peng Kaiqi, Wang Xuepu, et al. Reflections on the transformation of traditional wooden buildings in Qiandongnan Prefecture of Guizhou [J]. Wood Industry, 2018, 32(2):4.
- [2] Jiang Ming. Study on the cultural connotation of traditional wooden architecture villages [J]. Forest Products Industry, 2020, 57(1):3.
- [3] Zeng Wen. The application of China traditional culture in modern architectural design [J]. Heilongjiang Science, 2017, 8(4):2.
- [4] Yang Rui. Discussion based on modern and traditional architectural design [J]. China Interior Decoration Tiandi, 2018, 2018(001):265.
- [5] Lei Meng. Inheritance of traditional elements in modern architectural design [J]. Engineering Construction and Design, 2021, 2021(010):14-16.
- [6] Han Ming, Li Yajie. Analysis of the application of traditional elements in modern architectural design [J]. Housing and Real Estate, 2019, 2019(15):1.
- [7] Yan Tingting. Inheritance and application of traditional elements in modern architectural design [J]. China Interior Decoration Tiandi, 2019, 2019(002):198.
- [8] Lu Lihong. The application of traditional patterns in modern architectural design [J]. China Architectural Decoration, 2022, 2022(20):3.