

Case Study on Conservation and Renewal of Historic Buildings from the Perspective of Green and Sustainable Construction

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Abstract. With the continuous promotion of the concept of sustainable development and the constant development of cities, the preservation and renovation of historical buildings have gradually become one of the important issues in urban development. This article introduces the value, importance, sustainable concepts in historical buildings, application of green building technologies in historical building preservation, as well as a compilation of representative cases from both domestic and international perspectives. Based on this, personal viewpoints are proposed for future practices in historical building preservation and renovation, along with an analysis and summary of the trends in historical building development.

1. Introduction

Historical buildings with certain preservation value can reflect the history and cultural characteristics of a city. Historical buildings are the legal concept in China for traditional structures, which differ from cultural relics. In a sense, these buildings represent the "historical memory" of a city and are an indispensable link in its cultural development chain. Once destroyed, it is almost impossible to restore them.

Compared with new construction, the restoration of historical buildings requires thorough research and repeated validation of restoration plans to achieve precise design. Due to the significant historical and cultural value of many historical buildings, meticulous work is also needed during the restoration process to preserve their original appearance and demonstrate authenticity and integrity. Therefore, appropriate conservation techniques must be employed to minimize intervention, prolong the lifespan of the buildings, and embody sustainable development principles[1].

1.1. Research background

Historical buildings serve as tangible carriers that play a crucial role in enhancing people's confidence. Taking the ancient city wall of Xi'an, located in Shaanxi Province, as an illustration; it has now become a symbol of contemporary Xi'an and possesses distinctiveness due to the absence of intact city walls among other ancient cities across China. The size of Xi'an's city wall is moderate, allowing for both urban protection and complete exhibition of its charm. Furthermore, it stands as one among China's largest remaining ancient city walls.

Historical buildings as physical evidence of history,

carry the stories and values of their respective eras. At the same time, historical buildings are also an indispensable foundation for developing the tourism industry. With the improvement of living standards, people's spiritual needs are growing. In today's urban environment, historical buildings may even become symbols of cities and attract more long-distance tourists to visit. For example, Tianjin's Five Avenues area and Italian-style street have become AAAA-level tourist attractions in China, attracting numerous visitors.

1.2. Research significance

Historic heritage preservation is a planned activity aimed at protecting ancient buildings and neighborhoods, in order to promote the integration of local residents, culture, and history. In fact, it is also an essential component of green architecture by reusing existing buildings instead of constructing new ones. Preserving historical relics can also enhance urban competitiveness because they are unique historical structures that surpass many skyscrapers in terms of attractiveness.

In my opinion, historical buildings not only reflect the architectural forms and characteristics of the past era, but also reflect the stories that happened in the architectural space at that time. For the preservation and renewal of historical buildings, it is not only the reuse and revitalization of old buildings, but also the continuation of the spirit of the building place.

1.3. Research methods and principles

Some studies have summarized the following problems existing in the conservation and renewal of historical buildings:

1. Improper protection and large-scale demolition and

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construction led to the disappearance of a large number of historical buildings;
2.Lack of appropriate green sustainable protection means and active utilization methods;
3.Lack of green function evaluation methods for historical buildings[2].

The common method or means in the preservation and renewal of historical buildings is essentially how to deal with the relationship between old and new buildings. The methods and principles of preservation and renewal of historical buildings mainly include:

Original preservation: The preservation of historical buildings is conducive to maintaining the authenticity of history and culture, which is the standard advocated by the United Nations. Of course, the best thing for historical buildings is to maintain their original state, that is, almost all aspects of physical properties and spatial organization, the original atmosphere of the space, the formal content of the space, and the internal and external structures of the building, especially the environmental, structural and landscape characteristics, should be maintained intact. In this way, the original value of the historic building can be safeguarded in the best possible form.

Make only necessary alterations: For historic buildings that have been destroyed or damaged, it is necessary to maintain as much authenticity as possible when restoring them. The Venetian Charter sets forth and stipulates the universally recognized principles of restoration: the restored and replaced parts must form an integral part of the original building in order to maintain the greatest possible harmony and to be preserved or updated without compromising its artistic, historical, scientific or informational value[3]. For example, when the function of the supporting maintenance structure of a historical building is lost, the solid part can be repaired and replaced.

Put an end to large-scale demolition and construction: It is a normal practice to carry out necessary renewal and transformation of areas that are not suitable for development and areas that are in decline within the scope of urban built-up areas. However, in some places, urban renewal is transformed into simple land acquisition and storage and commercial development, large-scale relocation of original residents, and complete demolition and reconstruction of all buildings. This kind of "large-scale demolition and reconstruction" will inevitably lead to the disintegration of urban social structure, the disappearance of historical and cultural accumulation, and the destruction of natural ecological environment[4].

The condition and precondition for carrying out restoration work is that they are not destroyed. Historic buildings should be used in a manner that continues their original purpose, whether as a display of cultural relics or as a tourist attraction, taking care not to damage the building and its surroundings.

2.Sustainable concept and green building technology in preservation and renewal of historic buildings

2.1. The concept of sustainable conservation in historic buildings

The Athens Charter (1931), aimed at the preservation of ancient monuments and monuments, had an abstract plateau character, but in Le Corbusier's new Declaration of Athens in 1941, a more specific scope for the preservation of forms, including the structure and layout of buildings, was proposed[5].The Venice Charter, introduced in 1964, stresses the importance of sustainable environmental protection for the preservation and restoration of historic buildings. Specifically, it states that "when traditional techniques prove inadequate, any modern construction and conservation techniques supported and proven to be effective by scientific data can be used to enhance heritage sites."[6]. At the same time, the development of green buildings promotes the transformation of original buildings and the application of green building technology.

2.2. The emergence and application of green building technology

Green building technology has become one of the hottest trends in the construction industry. The benefits of applying green technology in buildings are comprehensive and far-reaching, with significant advantages for both new and existing structures. Green technology makes buildings more efficient and sustainable, thereby reducing their carbon footprint and impact on the environment.

2.2.1 The former residence of Duan Qirui in Tianjin, China

The city of Tianjin, where the author is located, has already implemented cases of green and sustainable protection design for many historical buildings. For example, the Architectural Design Institute of Tianjin University transformed the former residence of Duan Qirui in Tianjin by adding several glass domes on the new roof as skylights, as shown in Fig.1.These skylights are equipped with a reflection channel and diffusion system that can evenly and effectively illuminate the dome from morning to night using natural light. Even on rainy or cloudy days when natural light is needed, artificial lighting is not necessary, thus contributing to energy conservation and environmental protection, as shown in Fig.2[7].

The former residence of Duan Qirui will be renovated in 2021, and it will be used as the office space of China Lenovo Group because it is well repaired and activated and suitable for modern use.



Fig.1. Schematic diagram of the glass sharing space in the main annex building



Fig.2. Glass sharing space and beautiful Windows

2.2.2 Jing Yuan, Tianjin, China

As shown in Fig.3., Located in the Heping District of Tianjin, China, Tianjin Jingyuan was built in 1921 and was once the former residence of the last emperor of the Qing Dynasty, Puyi.



Fig.3. Present situation of Jingyuan in Tianjin

Since 2000, more and more residents have moved into the park. A large number of illegal buildings have been built in the courtyard, which not only affect the surrounding environment, but also are extremely inconvenient to use. All these made its original appearance destroyed, thus weakening the cultural connotation and the value of The Times.

In 2005, Tianjin Historical Style Building Finishing Co., Ltd. carried out renovation work on Jingyuan. During the renovation process, advanced technology and materials were introduced, the overall structure was strengthened, and the interior decoration was reorganized. The comparison of the roof before and after restoration is shown in Fig.4.

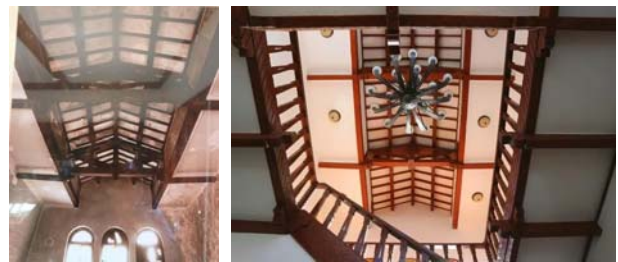


Fig.4. The roof before the restoration (left) and after the restoration (right)

According to relevant historical documents and materials, the Architectural Design and Research Institute of Tianjin University restored the original garden landscape, including the flower pool, bonsai and rockery in the front courtyard, the dragon fountain and flower bed in the west courtyard, and increase the landscape greening of the back yard to form an overall landscape greening space with the front yard[8].

It is worth mentioning that Jingyuan is the first historical style building to be relocated in accordance with local legislation, and its protection and rational utilization fully interprets the principles of "protection first, rational utilization, restoration of the old, safe and applicable" of Tianjin's historic style buildings, which is of great significance in the history of Tianjin's architectural cultural heritage protection.

2.2.3 Reichstag, Berlin, Germany.

After a brief introduction of the two domestic cases, the following will introduce a more well-known foreign reconstruction case - the German Parliament building, as shown in Fig.5.



Fig.5. Photo of the Reichstag Building

The Reichstag Building is located in the center of Berlin, which embodies a variety of architectural styles and was completed in late 1894. After a century of vicissitudes, the Capitol has long been in disrepair. In 1992, British architect Norman Foster participated in and won an open design competition organized by the federal government.

The goal of the renovation project is to generate electricity from waste heat, that is, excess heat is stored underground in the summer for heating in the winter, and cold water is released underground in the winter for cooling in the summer. For this purpose, a heating center and cooling chamber were built underground. As shown in Fig.6., a chamfered vertebra covered with 360 rotating and angular lenses is located in the center of the glass dome, which can reflect natural light into the building, so as to reflect the interior of the dome space, and the mapped space has a sense of future technology[9]. This allows more natural light into the meeting room below, as shown in Fig.7. Coupled with light from the courtyards on both sides of the building, the meeting rooms have bright light throughout the day, greatly reducing the need for artificial lighting.



Fig.6. Inside the dome of the Reichstag

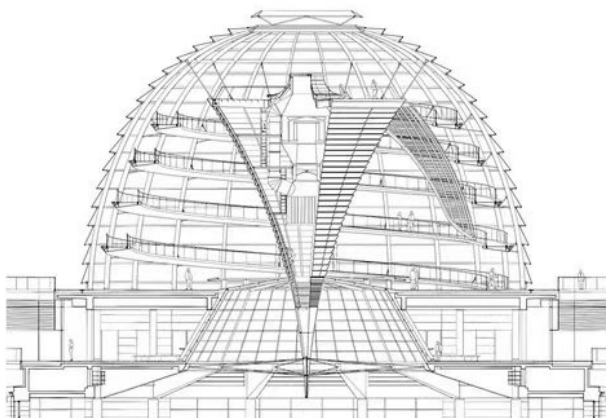


Fig.7. Dome profile

As shown in Fig.8., during the renovation of the Capitol Building, natural air, extraction and low pressure differential gas supply were used as much as possible for environmental and economic reasons. As shown in the picture above, fresh air enters from the air intake under the eaves of the west gate, enters the air outlet under the seats

of the conference room under the dome, and is eventually distributed throughout the hall. The rising hot air is sent out through an inverted conical pipe[10].

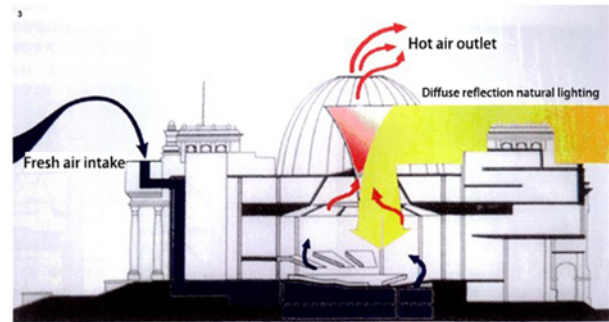


Fig.8. Ventilation and lighting in the Reichstag Building

The Reichstag is not only a successful renovation project in the preservation and renewal of historic buildings, but also an attempt by architects to integrate green building technology into the transformation of historic buildings.

3. The future development trend of historical buildings

For historical buildings, the historical and cultural charm contained in the buildings themselves is already very rich, so in the practice of sustainable development of historical buildings, we should pay more attention to whether the protection of the buildings themselves is proper, and what kind of deep thinking can be given to visitors or users after the combination of historical buildings with new technologies and materials. It is important to dig into the history of the building itself, and some historical buildings give us not only historical knowledge, but also reflective learning about the era of the building, such as how we can learn from the war memorial, so as to avoid the risk of another war in the future[11].

What we want to protect is the real historical buildings, so that they can be our material and spiritual wealth to achieve a longer heritage. Moreover, with the support of green building technology, it can effectively improve work efficiency and work completion, and the choice of materials can be more green and environmental protection, effectively improve the utilization of resources, but also reduce the pollution and damage to the environment. In addition, the use of local craft skills also pay dividends in terms of reducing carbon and would hopefully, in the longer term embed the concept of local sourcing and procurement from management tendering for projects through the operatives undertaking the sustainable repairs[12]. It can be said that green building technology has brought greater convenience to the protection of historical buildings.

4. Conclusions

This paper analyzes the protection and renewal of the historical building background, the development status and how to use the green sustainable development thought

briefly, and puts forward the inevitable trend of the development of the historical building in our country in the future. It is necessary to actively explore and innovate ideas, and persist in promoting the protection and renewal of historical buildings. Because architecture belongs to the city, it is a dynamic system with its own metabolic function; Whether we protect too much or not, improper development will disrupt the system. All we have to do is follow the laws of metabolism.

In the future development, with the continuous progress of science and technology, it is more necessary for the conservation and renewal of historical buildings to combine the continuously updated sustainable concept with green building technology, so as to be more activated and concrete. Our future conservation and renewal of historical buildings may require the integration of multi-disciplines, cross-disciplines and knowledge. Therefore, I think it is necessary for young architects as well as architecture students to expand their knowledge of the basic theory, so as to better promote the green and sustainable development of the historical buildings in our country.

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