Inheritance and Update of Chinese Traditional Windows in Landscape Architecture

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Abstract. Chinese Architecture has a long history, which makes Chinese buildings more than shelters. Chinese traditional windows are just like buildings, having more meaningful contents. They have very high cultural and artistic significance. However, nowadays, when the word “window” is mentioned, most people regard it as a structure used for letting in the natural light. Chinese traditional windows are gradually replaced by modern windows, especially after the 1980s, for traditional windows are somehow not satisfied with the demands of modern life. After the reform and opening, China has learned the technology of modern windows made of aluminum alloy from Europe, the United States, Japan, and other developed countries. As a result, the cultural connotation of Chinese traditional windows art in landscape architecture is disappearing. To inherit traditional Chinese windows in landscape architecture, Chinese architects need to update traditional Chinese windows by using modern materials, techniques, and methods. The first part of this article discusses the main physical elements of traditional Chinese windows of landscape architecture. The second part of this article discusses the cultural connotation of Chinese traditional windows art of landscape architecture. The last part of this article discusses how to use new materials and technology to retain and update some parts of traditional windows that are of great significance in Chinese traditional windows art of landscape architecture. And there are three main approaches. Firstly, use WPC to replace traditional wood, which has better properties and keeps the feelings and cultural connotation brought by wood. Secondly, use fewer materials and simple shapes to simplify traditional windows bars to make them suitable for modern life. Thirdly, rethink the design of windows and design the windows and the landscape as a whole. In the future, the new Chinese windows of landscape architecture will be popular all over the country again.

1 Introduction

Famous architect I. M. Pei once said, "In western countries, windows are just constructions whose function is letting light and fresh air get into houses. However, in ancient China, windows were regarded as picture frames, and gardens were always outside them [1]." Besides, windows themselves are also decorations of buildings. After the reform and opening, China has learned the technology of modern windows made of aluminum alloy from Europe, the United States, Japan, and other developed countries. As a result, windows of most landscape architecture in China make great progress in thermal performance. However, they are gradually losing their original aesthetic significance, for China didn’t keep its wealth successfully during learning. From the perspective of historical development and architectural structure, windows in China retain and update their practical functions, but they miss their spiritual connotations. Nowadays, many articles introduce traditional Chinese windows art in detail, analyze its cultural connotation and ask the designer to use it in modern buildings. However, they ignore that some traditional techniques and appearance are not suitable anymore in modern architecture. And they don’t explain how to update and inherit the traditional Chinese windows art in detail. In this article, some approaches can be taken as a reference of how to inherit and update traditional Chinese windows in landscape architecture.

2 Methodology

The first part of this article discusses the main physical elements of traditional Chinese windows of landscape architecture. The second part of this article discusses the cultural connotation of Chinese traditional windows art of landscape architecture. The last part of this article discusses how to use new materials and technology to retain and update some parts of traditional windows that are of great significance in Chinese traditional windows art of landscape architecture.

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3 Main Physical Elements of Chinese Traditional Windows

3.1 Windows Structure

The classification of traditional landscape architecture windows can be varied. According to different standards, they can be divided into different types. In this article, traditional landscape architecture windows are divided into 2 main types: empty and leaky windows [2]. The empty window only has the window frame, and the window frame is set in the window opening. The leaky window is composed of the window frame and the window bar. The window frame and the window bar are the main structural components of traditional landscape architecture windows. Meanwhile, their patterns are abundant and colourful.

Figure 1. Leaky Windows

Figure 2. Empty Windows

3.1.1 The Patterns of the Window Frame

Although the window frame patterns are complex and varied, they are still able to be classified. According to the shape of the window frame, it can be divided into abstract shapes and concrete shapes. The abstract shape includes square, rectangle, Chinese character Ya shape, regular hexagon, long hexagon, regular octagon, long octagon, circle, sector, and so on [3]. The concrete shape refers to those shapes having borders of specific objects, such as the autumn leaf, sunflower, pattra leaf, Chinese flowering crabapple, plum blossom, vase, water-caltrop flower, lotus flower, Ru Yi, and so on [3].

3.1.2 The Patterns of the Window Bar

The patterns of the window bar are also varied and abundant, just like the patterns of the window frame. According to incomplete statistics, there are more than 200 kinds of patterns in just one garden named Suzhou Humble Administrator’s Garden. However, the patterns of the window bar can also be classified based on the shapes.

These patterns can be roughly divided into abstract shapes, concrete shapes, and comprehensive shapes. Abstract shapes are mostly composed of straight lines, arcs, circles, and so on. Some of the window bars use only one element alone, and some of them use mixed elements, and they are mainly based on one element to avoid disorder and confusion. For example, common in the graphics made by straight lines are Square, wanzi, huizi, jingzi, shizi, I-shaped, ice crack, and so on. As for graphics made by arcs, there are qian scale, haitang, ruyi, fangsheng, bottle shape, straight lattice, broken sub straight lattice, shutiaochuan, qingtiaochuan, zhengwenchuan, one yard, three arrows, diamond, square, twill, blanket, windmill, inserted angle, random pattern, soft foot pattern, Bubu brocade, lantern brocade, huiyun pattern and so on. The graphics made by mixed elements include ten thousand characters begonia, cross plum, random borneol inlaid plum, sunflower soft landscape ten thousand characters, hexagonal plum, and so on [3].

Concrete shapes are based on real objects. For example, there is a wide range of plants, such as pomegranate, lotus, plum, grape, orchid, bamboo, sunflower, begonia, leaf, fruit, lace, flower knot. There is a wide range of animals, such as birds, dragons, bats, butterflies, frogs, goldfish, carp, cranes, etc. Besides, qin, chess, calligraphy, painting,
dark eight immortals, auspicious miscellaneous treasure are included in traditional Chinese windows as well [3].

![Figure 5. Abstract Shape](image)

![Figure 6. Concrete Shape](image)

Comprehensive shapes are composed of both abstract elements and concrete elements mentioned before.

### 3.2 Windows Materials

The classification of traditional landscape architecture windows can be varied. According to different standards, they can be divided into different types. In this article, traditional landscape architecture windows are divided into 2 main types: empty and leaky windows [2]. The empty window only has the window frame, and the window frame is set in the window opening. The leaky window is composed of the window frame and the window bar. The window frame and the window bar are the main structural components of traditional landscape architecture windows. Meanwhile, their patterns are abundant and colourful.

However, generally speaking, most Chinese traditional windows of landscape architecture are mainly made of wood [4]. There are two main reasons why ancient Chinese choose wood as the main material of traditional windows. For one thing, traditional Chinese buildings are generally based on wood structure, for it is easy for ancient Chinese whose tools and techniques are limited to obtain, process, and decorate. Using wood as the main material can cut down the time spent on construction effectively.

For another, in Chinese culture, wood symbolizes life because it is warm. And in some traditional literatures, wood was given profound meanings and high praise. For example, wood means tenacity, honesty, and loyalty.

Besides, in some outdoor spaces, more durable and solid materials are used, such as masonry, imbrex, mortar, etc. And most of them are composed of two or more kinds of materials.

### 4 Cultural Connotation of Chinese Traditional Windows

#### 4.1 Cultural Connotation of Chinese Traditional Windows' Aesthetics

Sections should be numbered with a dot following the number and then separated by a single space: When ancient Chinese designed and built landscape architecture, they often managed everything in person and considered every detail, including windows, repeatedly to express the noble character they pursued. Shengtao Ye, one famous writer, once said, “The design and carving of doors and windows in traditional landscapes in Suzhou are the great representatives for the traditional Chinese arts. Generally speaking, even if the doors and windows are simple and original in forms, they are still elaborate and beautiful [2].” In other words, there are profound thoughts and meanings in the design of windows’ frames and bars. The cultural connotation of Chinese traditional windows’ aesthetics is more brilliant than windows’ appearance, which should be learned and inherited by a Chinese architect.

The cultural connotation of Chinese traditional windows’ aesthetics was created based on Confucianism, Taoism, and Buddhism, which were popular among ancient Chinese during that time [2]. Firstly, in the Confucian culture, people were advocated to take part in political activities. Ancient Chinese used symmetrical and neat graphics to express such a spirit, especially those abstract graphics mentioned before. Octagon and hexagon in traditional Chinese windows are exemplars. Secondly, in the Taoist culture, people were advocated to obey the natural rules and avoid being connected with society to improve themselves physically and mentally. The pursuit of freedom and longevity is its purpose, shown in some graphics used in traditional Chinese windows, such as dark eight immortals, five blessings and longevity, pan chang, and pan tao. Thirdly, in the Buddhist culture, the Buddha is the role to help people get rid of troubles and annoyance. Therefore, the graphics in the Buddhist culture were mainly used by ancient Chinese to pray for auspiciousness. Eight treasures, lotus, and ten thousand characters were the common elements.

Meanwhile, as an important part of people's social lives, traditional Chinese windows are closely related to social life and customs [2]. According to the study of the traditional Chinese windows in Suzhou classical landscapes, we can find out that some shapes of the traditional Chinese windows in Suzhou classical...
landscapes are designed on the subject of auspiciousness. Therefore, the shape of traditional Chinese windows implies folk custom and spirit. Some shapes express people’s wish for wealth, official position, academic degree, safety, offspring, and so on. The reasons why ancient Chinese used these shapes are not only to decorate the traditional windows of landscape architecture but also to express the ideas of the owner of the garden.

4.2 Cultural Connotation of Chinese Traditional Windows’ Functions

Chinese traditional windows are not designed just for letting in light and air. They are one part of the structure used to deal with the relationship of inner space and outer space. The inner space refers to the space that people carry out daily life activities, such as sleeping, eating, or receiving visitors. And outer space refers to nature, including both artificial and natural landscapes. The boundary between the inner and outer spaces becomes a distinction because of the existence of windows, which helps the designer mix the natural space with human space. In other words, if a person stands in one traditional Chinese landscape architecture, he will find the windows’ positions are the nearest place to nature among the whole building, and he will forget that he is still inside for one second. Therefore, learning why ancient people created Chinese traditional windows art, it is obvious that windows in landscape architecture show ancient Chinese's willingness to be exposed to nature.

![Figure 7. Windows with Beautiful Scenery](image)

Chinese traditional windows of landscape architecture are also regarded as picture frames. The windows and the outside landscape form pictures together hung on the wall just like wallpapers. But these pictures are more real, natural, and beautiful than wallpapers. Generally, in these pictures, mountains, rocks, flowers, and trees are the center of the painting. The pines, Osmanthus, bamboos, and oranges may only occupy half of the picture, while the blank space is dedicated to distant visitors and clouds [5]. Besides, these beautiful and delicated pictures gave the ancient poet creative inspiration. As a result, there are many poems about traditional Chinese windows of landscape architecture written by ancient Chinese poets, almost all of which express the praise and appreciation about the art of traditional windows. And sometimes they just used the traditional windows to express their feelings, such as anxiety, yearning, and so on. Especially Wang Wei, a great poet of the Tang Dynasty, was an expert at writing the scenery outside the windows. For example, the window faces the Peihe River, and the door crosses the boat of Chu people; willow color spring mountain Ying, pear night bird hide, North window under peach and plum, sit idle but incense. Seeing the beautiful scenery through the windows and hearing nature, the poets got their romance and inspiration [5].

5 Inheritance and Update of Chinese Traditional Windows in Landscape Architecture

5.1 Replace traditional windows materials

After thousands of years of exploration, ancient Chinese have created and summarized a complete system of traditional Chinese windows in forms, structures, technology, and materials. As the article discussed before, traditional Chinese windows of landscape architecture are mainly made of wood, for it is easy to obtain and handle. Meanwhile, wood implies the pursuit and respect for nature and some noble characters.

Wood has good heat-retaining properties. However, its poor corrosion resistance, easy cracking, and other problems also affect its service life. And its cost of maintenance is quite high [6]. Besides, in the past, using wood as the main material means cutting down trees, which will cause serious environmental problems, such as soil erosion. Meanwhile, the resources of high-quality wood required for the production of windows in China are very limited. Therefore, after reform and opening in the 1980s, considering the high production efficiency, low cost, and rich raw material resources, the Chinese mainly use aluminum alloy and plastic to replace wood as the main material of windows. It is learned from Europe, the United States, Japan, and other developed countries [7]. Nowadays, in China, almost 50% to 60% of the windows are made of aluminum alloy, and 20% of the windows are made of plastic [7]. These two kinds of modern materials are cheaper than wood. Although these two kinds of modern materials used on windows are stronger and cheaper than wood, they don’t have as much cultural connotation as wood has. What’s more, losing wood means losing the opportunity to get in touch with nature.
With technology development, one new material, wood-plastic composites (WPC), has shown up on the market. It is a kind of composite material made of the thermoplastic polymer as matrix and wood fiber as filling and reinforcing material [8]. Compared with traditional wood, they don’t have too much difference in appearance. However, WPC is waterproof, moisture-proof, anti-corrosive, and mothproof, and not easy to crack, which are excellent properties that wood does not have. Meanwhile, WPC has longer service life than normal wood because the outer parts protect their cores from water. In addition, there is no need to spend a large amount of money on maintenance. The most important advantage is that the raw materials of WPC are abundant, including low-quality wood, waste wood, wood processing residues, forest tending and cutting residues, and even crop straw and other biomass materials, waste plastics, synthetic waste fiber, and other "white pollution" sources [8]. As a result, WPC is an environmentally friendly material that can be regarded to deal with organic solid waste. Compared with aluminum alloy and plastic, WPC has better performance on thermal and thermal, and mechanical properties. In addition, WPC is warmer than aluminum alloy and plastic and keeps people close to nature. WPC help the Chinese to inherit the cultural connation of wood, for people will associate WPC with wood at first sight of their appearance.

In short, WPC is a good replacement for traditional wood because it has better properties and keeps the feelings and cultural connation brought by wood.

### 5.2 Simplify traditional windows bars

Nowadays modern windows which are boring and somehow ugly need to be decorated. Ancient Chinese had already figured out one approach to solving this problem. Using windows bars to decorate the windows and express some meaningful thoughts, pursuits and wishes are worth learning. However, in the past, the forms of windows bars are too complex to be applied directly to modern windows. Here are two main reasons why modern Chinese people should simplify the bars of the windows.

Firstly, producing more complex windows bars means using more materials and energy, creating more waste. Meanwhile, as we all know, natural light is good for people’s mental and physical health, and it is a necessary and important resource of lighting. However, more complex windows bars can block more light from coming into houses. As a result, people have to use more artificial lights for lighting, which may also waste more energy. Nowadays, many countries have reached a consensus that the total carbon emissions should be reduced as soon as possible to ensure that the global average temperature rise does not exceed two degrees Celsius to deal with climate change and advocate low-carbon life. Under this consensus, low-carbon buildings are becoming an irreversible trend among the development of the construction industry [9]. Just one such complex window doesn’t have a huge impact on our environment. However, what will happen if all the effects on the nature of

### Table 1. Physical and chemical properties of wood plastic composites

| Property                                         | Value         |
|--------------------------------------------------|---------------|
| Distance (m)                                     |               |
| Velocity (ms⁻¹)                                  |               |
| Moisture content (%)                             | ≧ 2           |
| Hardness (HRR) (HRR)                            | ≧ 58          |
| Water absorption thickness expansion (%)         | ≧ 1           |
| Static bending strength (MPa)                    | ≧ 20          |
| Bending modulus of elasticity (MPa)              | ≧ 1800        |
| Surface wear resistance (G/100r)                 | ≦ 0.08        |
| Low temperature drop hammer impact, number of fractures (pieces) | ≦ 1 |
| State after heating                              | No bubbles, cracks and pitting |
| Dimensional change rate after heating (%)        | ±2.5          |
| High and low temperature repeated size change rate (%) | ±20.2 |
| Screw holding force (n)                          | ≥ 1000        |
| Board                                            | 800           |
| Weatherability (MPa)                             | ≥ 16          |

Figura 8. Market scale of global wood plastic composites industry in 2012-2020 (unit: US $100 million)

Figura 9. Wood plastic composites
thousands of windows with complex bars are added up? Therefore, to follow the trend, we should somehow reduce the materials used on the windows bar and make sure rooms can get enough natural light.

Secondly, with the development of modernization, some traditional forms of windows bars cannot match modern people’s pursuit of modern art and new aesthetic habits. Nowadays, minimalism originated in Western Europe in the 1920s and is a very important art form globally. Chinese art is also impacted by such a style greatly [10]. Modern Chinese have already been tired of appreciating complex but deliciated artifacts, including windows bars. “Less is more” has become the main principle of Chinese designers. They look forward to creating a brief but colorful space. Therefore, many concrete shapes are hard to be accepted by modern Chinese under the effect of modernization. Meanwhile, with the fast and deep globalization, many news shapes of windows bars may show up.

At last, Gropius once said: "real tradition is the product of continuous progress. Its essence is moving, not static. Tradition should promote people's continuous progress.” Using fewer materials and simple shapes are the main approaches to simplify traditional windows bars to make them suitable for modern life. Some designers have tied, and here are few examples.

![Figure 10. Suzhou Museum](image)

![Figure 11. One Project Designed by Yufan Zhu](image)

5.3 Rethink of windows design

Designing windows of landscape architecture is definitely not as simple as making a hole on the wall. Windows should be regarded as frames of beautiful pictures like the article discussed before, which means what people can see through the windows is also one of the most important parts of windows design. In other words, how to pick windows’ positions and design the landscape cannot be divided, which is always ignored by designers. However, in ancient Chinese windows design, one main guideline can be applied to modern windows design.

Although all kinds of windows have their characteristics, no matter what kind of windows, they all have a common design guideline. When ancient Chinese designed the windows of the landscape architecture, they all couldn’t escape from it. This principle mainly has two meanings. The first one is that the landscape outside the windows should have abundant and different layers that can ensure that people cannot learn the whole things outside the buildings. All the layers have relationships with each other, and they combine a beautiful picture. The second meaning is that visitors can get different views from different windows and directions, even for the same landscape. And with the change of tourists' position, they can also feel the change of scenery, just like they are wandering in an amazing painting. By following this principle, not only is the shapes of the windows themselves beautiful, but the whole scenery composed of both windows and landscapes is wonderful and attractive.

To inherit the cultural connotation of Chinese traditional windows’ functions mentioned before, architects need to rethink the design of windows by following the principle. The most important part is that they need to design the windows and the landscape as a whole.

6 Conclusion

Chinese traditional windows art in landscape architecture is the precious product of ancient Chinese craftsmen, reflecting their thinking on architecture design. These delicate windows show how ancient Chinese deal with light, heat, landscape, and human feelings. By using windows, ancient Chinese successfully integrate nature and architecture to express the will to be in harmony with nature at that time. Meanwhile, ancient Chinese used them for blessings. However, traditional Chinese windows are gradually replaced by modern windows, especially after the 1980s, for traditional windows çconnation of Chinese traditional windows art in landscape architecture is disappearing. To inherit traditional Chinese windows in landscape architecture, Chinese architects need to update traditional Chinese windows by using modern materials, techniques, and methods. Firstly, use WPC to replace traditional wood, which has better properties and keeps the feelings and cultural connotation brought by wood. Secondly, use fewer materials and simple shapes to simplify traditional windows bars to make them suitable for modern life. Thirdly, rethink the design of windows and design the windows and the landscape as a whole.

This article is helpful for Chinese architects. For one thing, it can somehow make them take windows design seriously, which is not just making a hole in the wall. For another, the article supplies them with three approaches that can be used to make windows colorful and interesting.
Meanwhile, when they use these approaches, the traditional Chinese windows art is inherited and updated. However, as we all know, windows are related to buildings’ function, appearance, and so on. Therefore, in some special cases, these approaches cannot be applied well. Other researchers should explore some special cases and try to find out better ways. In the future, the new Chinese windows of landscape architecture will be popular all over the country again.

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