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## Study on modern application of traditional building materials based on geographical background

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### Abstract

In the pre industrial age, building materials were taken directly from nature, and building materials formed a natural link between the building and its geographical location. After the industrial revolution, with the development of concrete, glass and other modern building materials, the relationship between architecture and its area was fragmented. The city building and local environment does not adapt to each other, for reflection and correction of this situation has continued since. The traditional building material advantage is the thermal performance and other advantages. In the process of architectural design and construction, the use of traditional building materials can save energy, manpower, and practice the concept of ecological environmental protection. Therefore, the traditional mining potential of materials has become an important means of integration of city construction and environment in the specific design process, through the material caused by physical experience, emotional and cultural resonance, in response to the geographical environment of city building. In this paper, the "city" environment is understood as "urban climate", "urban landscape" and "urban culture". Discuss from the three aspects, through the various elements associated with "city", the traditional building material is used for constructing multi-level association between city and environment, resist globalization since the geographical features and cultural diversity and homogeneity of the attenuation of erosion, provide a useful reference for the application of building materials city.

**Keywords:** Traditional material; Regionalism; urban climate; urban landscape; urban culture

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### 1. Introduction

The traditional building materials refer to the floorboard of traditional building structure of all materials, including the sintering products (brick and tile), gravel, limestone (lime, gypsum, wood and bamboo). The traditional building materials have the advantages of saving materials, transportation energy consumption, good thermal performance etc. At the same time, the use of traditional materials directly reflects the regionalism, but regional material does not only mean the use of traditional materials. It should focus more on the face of the specific geographical environment, and how traditional materials to reflect the building here.

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In the background of national cultural renaissance and regional culture, architects have made many unremitting attempts in the contemporary interpretation of traditional building materials. For example, Wang Shu, the first Chinese architect who won the Pritzker prize in general, combined the local building materials and traditional construction techniques, and adopted modern architecture language to carry on the form writing, thus conveying the unique Chinese cultural charm. However, compared with the modern building materials, the traditional building materials have worse physical and chemical properties. If they want to be widely used in urban buildings, they need to improve their physical and chemical properties.

At present, scholars have carried out the practice of traditional materials used in the city, there will be a rising trend of traditional building materials in the form of performance. The trend pays more attention to the surface properties of materials on the image perception of traditional materials presented. However, the selection of materials in traditional architecture should not only cling to the surface, but there are more deep-seated association pattern related to the city climate, city landscape and the local cultural background. Through the selection, organization and performance of traditional materials in the urban context, we hope to reconstruct the link between architecture and environment. Case selection avoids those specious forms, and tries to reflect the traditional materials and the regional conditions of the city, reflecting the regional features, cultural connotations and the spirit of the times.

## 2. The application of traditional building materials in urban environment

"City" environment is understood as the composition of the three elements, the "city climate", "urban landscape" and "urban culture". Through the analysis of the application of traditional materials in modern urban environment, we try to find the difference of contemporary urban architecture and resist the erosion of regional features and cultural diversity and the erosion of homogeneity caused by globalization.

### 2.1 Traditional material performance to adapt to urban climate

Climate is a general meteorological situation that has been observed for many years in a given area, and has certain regional stability and regional differences. The human settlement environment on the earth can be divided into five climatic zones, which can be divided into heat preservation priority climate and heat insulation priority climate by the different ways how materials adapt to the climate of the city. The heat preservation priority climate zone refers to the great temperature difference inside and outside the chamber, and the traditional material is used to block the internal heat dissipation (cold zone) or the acquisition of external heat (dry hot zone). Material use "wall culture" presents, that is, thick closed walls, regular volume, control the size of the opening. Heat insulation priority climate zone refers to the tropical and subtropical areas. These areas refer to the small temperature difference inside and outside the chamber, and the rainfall is rich. The traditional materials are mainly based on the ecological and aesthetic treatment of sun shading and sun protection components, focusing on solving the sun shading, heat insulation and ventilation cooling of the wall openings.

Table 1. Representative traditional materials in different climatic zones in China (Mild climate, heat preservation and insulation requirements are negligible)

Climate zoning in China	Severe cold area/ Cold area	Hot summer and cold winter zone	Hot summer and warm winter zone
Heat preservation	√	√	-
Heat insulation	-	√	√
Representative traditional materials	immature soil、 stone、 fur	immature soil、 stone、 wood、 seaweed	wood、 bamboo



Case: The China Academy of Art Xiangshan campus expert reception center (Zhejiang, Hangzhou, China)

Climate survey: The expert reception center of Xiangshan campus of The China Academy of Art is designed by Chinese architect Wang Shu, located in Hangzhou City, Zhejiang Province, China. Hangzhou is in the subtropical monsoon zone, which has the hot summer and cold winter. The typical climatic characteristics in Hangzhou is hot, humid summer climate and cold, dry in winter. At the same time, Hangzhou is one of the four big stoves in China. Heat preservation and heat insulation needs equal attention.

Material performance: In order to cope with the Jiangnan region of hot summer and cold winter climate, the villages in the south of the Yangtze River use immature soil to create comfortable indoor temperature.



Fig.1. Soil and wood use in the reception center.

Immature soil is local materials, and has good thermal properties. The buildings made by immature soil can be warm in winter and cool in summer. The construction materials is adapt to the local climate. The designer selected soil, wood and other traditional building materials, to explain the form language of modern architecture. The expert reception center has a large area of rammed earth wall and special-shaped wooden roof. After the removal of the outer surface of the rammed earth wall of the reception center, there is a very delicate horizontal cascade effect, reminiscent of the rendering of the Cascade Mountains in the traditional landscape painting. The immature soil wall uses loess and laterite to make the wall has "mixed color" effect. The special-shaped roof made of wood which is another kind of traditional building material, has two functions at the same time. First of all, the wooden roof provides overall protection for a large number of immature soil walls, which is not affected by the wind and rain erosion. Secondly, the wooden roof and the concrete roof form a double deck roof, which is beneficial to the ventilation and heat insulation in summer.



Fig.2. Color effect of soil wall in reception center.

Based on the thermal performance of the material and aesthetic characteristics, the building is simple and concise modern vernacular. In terms of material performance that adapts to regional climate, the building offers excellent answers to both ecological and morphological aesthetics.

## 2.2 Traditional material performance to response to the urban landscape

The constructed urban landscape is composed of buildings and its limited public space, which is based on the natural landscape, and permeates different cultural concepts and settlement structures of human beings. To respond to the urban landscape, a holistic approach to the relationship between architecture and the city is needed to examine the placement of new buildings. The traditional materials responded to the city landscape are mainly in two ways, the first is the formation of structural skin material traditional materials using modern structure technology, between the epidermal structure and city landscape into the whole or through the contrast of old and new contrast with the original building. The second method is to use

traditional building materials to form non structural epidermal materials, from the color, texture, texture of three aspects to respond to the urban landscape.

Case: Modern wooden structure theme museum (Jiangsu, Suzhou, China)

Landscape analysis: The base is located in the Jiangsu horticultural exposition exhibition area. The modern wooden structure theme museum is the main exhibition hall, and there are three exhibition halls, including the technical exhibition hall, the cultural exhibition hall and the Ecological Exhibition Hall. The whole park is made up of a number of unique wooden structure buildings, while the modern wooden structure theme museum faces the green open public space. The present urban landscape requires new buildings to connect modern architectural forms with traditional building materials, to connect artificial and natural, and to make new buildings more harmonious.

Material performance: The modern wooden structure theme museum design concept comes from the characteristics of the southern net image. Its top surface is a curve surface, similar with the architectural style of the Taihu tourist center echoes. The wooden structure reticulated shell system of the main exhibition hall is the first in the world, with a maximum span of 45 meters. The building is made of high tenacity wood, bent in proper order, and constructed with curved wood structure. The component is processed by robot mass customization. The wooden skin structure shapes the organic whole form of the building and creates a flowing and flexible interior space. The main museum integrates the site environment with the attitude of being close to the earth, and realizes the integration of Chinese traditional wood technology and modern science and technology.

### 2.3 Traditional material performance related to urban culture

The regional culture mainly includes the macroscopic traditional culture background and the concrete place spirit. Therefore, the traditional architectural materials associated with regional culture mainly have two ways: showing traditional culture and fitting place emotion. The traditional building materials used to display traditional culture are mainly used by the contemporary translation of traditional architectural symbols, or surface color and texture of the semantic presentation to construct the deep relationship between contemporary architecture and traditional culture. Different place and atmosphere can trigger different place feelings of the people. As a place for emotional projection, the buildings should fit in with the place and emotion. The conjunction of the place emotion is realized mainly by the structural metaphor of materials and the emotional symbol of surface color and texture.

Case: Museum of imperial street in Southern Song Dynasty (Zhejiang, Hangzhou, China)

Cultural background: The base of the imperial Street Museum in



Fig.3. Wooden roof

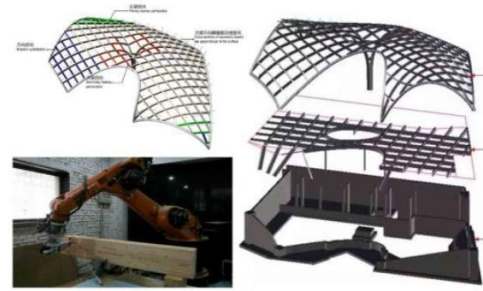


Fig.4. Wooden reticulated shell system



Fig.5. Museum of imperial street in Southern Song Dynasty



the Southern Song Dynasty is located in the road relics of 5 historical periods of the Southern Song Dynasty, the Yuan Dynasty, the Ming Dynasty, the Qing Dynasty and the Republic of China. The traditional wood is selected as the breakthrough point of the Southern Song culture background and the construction technology of the south of the Yangtze river.

Material performance: The whole building is covered with a large wooden canopy. The wooden ceiling draws lessons from the arch structure of the local domain of southern Zhejiang ancient bridges. The wooden roof is made of locally concealed steel structural small components, so that the structure has a large span, small materials and less fulcrum, so as to build a roof with dynamic strength,



Fig.6. Rainbow-shaped bridge and themuseum of imperial street in Southern Song Dynasty

which enriches the fifth elevation of Zhongshan Road. Visitors enter the entrance, you can feel the continuous structure of wooden arch, giving a strong visual perception. At the same time the application of wood arch structure is also reminiscent of eternal masterpiece "Riverside Scene at Qingming Festival" appearing in the form of rainbow-shaped bridge. The design of wooden roofs reflects the morphological relationship between modern wood architecture and traditional construction culture.

### 3. Summary of the application of traditional building materials in urban environment

In architectural design, the application of traditional building materials is in a dialectical and contradictory relation with the urban environment, and the material and environment are the basic elements of architectural design. The use of traditional building materials should not only become superficial decoration and form games, but should also be adapted to the urban geographical environment, and conform to the city image and cultural connotations. Using the elements of regional structure as a guide, the traditional building materials used in the city have three main feasible way: the traditional building materials used alone to play its insulation performance to adapt to city climate, combined with the new technology and new materials to respond to the urban landscape and related to the urban culture. As the traditional building materials used in urban architectural design strategy, the above three are complementary, unified whole.

However, the traditional building materials in the modern urban construction system, because of its limitations, seems inadequate. First of all, the traditional building materials are restricted by their physical properties (such as compression resistance, durability, etc.), and it is difficult to meet the requirements of the city building materials strength, span and so on. Secondly, the traditional building materials are regarded as a symbol of backwardness by the public, which leads to the construction of traditional building materials now used in small towns, and is not common in urban architecture.

Nowadays, the traditional materials are improved and combined with some new materials with strong bearing capacity and large span. These measures have improved the physical properties of traditional building materials and made them able to discard some of their shortcomings and radiate new vitality. At the same time, with the awakening of cultural diversity and traditional cultural awareness, traditional building materials are more widely accepted, and traditional building materials can be used as exterior leather decoration.

### 4. Conclusion

City climate, city landscape, city culture is the objective existence preceding architectural design behavior, which can be regarded as the external factors that restrict the selection of materials, but also often become active conditions with regional characteristics of his work. The application and performance of building materials are closely related to other factors, especially the urban environment in which the building is located. The modern application of traditional building materials should reflect the regional culture while presenting the times. Meanwhile, it should adapt to the urban climate, respond to the urban landscape and relate to the urban culture. At the same time, the development of new materials and technologies provides a broader space for traditional building materials in architectural creation. With the support of new technologies and new concepts, traditional building materials represent modern architecture in its own unique way, displaying its immortal charm.

## References

- 1) Siyou, Chan. (2014) **Study of regional properties of building skin materials**, South China University of Technology.
- 2) Chenwei, Luo. (2013) Study on the theory and design strategies of contemporary building materials, Shanghai Jiao Tong University.
- 3) **Xiaodong, Zheng. (2012) Study on the use strategy of traditional materials in Contemporary Chinese architecture under construction context**, Tsinghua University.
- 4) Xiaolong, Chen. (2015) A case study of modern application of traditional building materials, Xi'an University Of Architecture And Technology.
- 5) **Miao, He. and Gong, Liu. (2006) Modern architecture under the interpretation of traditional building materials, Chinese and foreign architecture, Page(189-192).**
- 6) Sheng, Song. (2007) Some thoughts on the creation of contemporary regional architecture, Huazhong Architecture, Page(35-39).
- 7) **Xun, Shao. (2011) The application of traditional materials in today's construction and creation**, Xi'an University Of Architecture And Technology.
- 8) Yonggao, Shi. (2007) Concealment and emergence -- a study of the construction of materials and the dual nature of space., Southeast University.
- 9) **Jingtang, He. (2012) Corpus of Jingtang He, Wuhan: Huazhong University of Science and Technology press.**
- 10) Xinwei, Xue. (2012) Research on material construction of indigenous architectural epidermis, Dalian University of Technology.
- 11) **Najia, Sun. (2016) The small paths diverge from the tile Hill, The China Academy of Art.**
- 12) Shu, Wang, and Wenyu, Lu. (2014) Wa Hill - The China Academy of Art Xiangshan campus expert reception center, Architectural Journal, Page(30-41).
- 13) **Xiaoyu, Gao. (2014) New and old: a study of the use of old materials in Wang Shu's architectural creation**, Nanjing University of Technology.
- 14) Xin, Wang, and Qiuye, Jin. (2014) Zhidizhitian, architectural nature -- Dialogue on "waterfront mountain", Architect, Page(100-114).
- 15) **Bo, Liu. (2016) Wooden structure construction of Jiangsu Horticultural Exposition, International wood industry, Page(06-07).**
- 16) Xiang, Wang. (2017) Jiangsu horticultural exposition displays wooden structure building, Building technology, Page(48-49).
- 17) **Shu, Wang. (2012) Royal Street Museum, Hangzhou, Zhongshan Road, World Architecture, Page(122-127) .**
- 18) Delin, Lai. (2013) From the modern architecture "painting" discourse of the development of Wang Shu building, Architectural Journal, Page(80-91).
- 19) **Lingbo, Qiang. (2014) Study on the artistic conception of Wang Shu - artisan architectural works**, Xi'an University Of Architecture And Technology.

