Application of Local Materials in the Renovation Design of Local Buildings

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Abstract. In the process of urbanization, the gradual loss of the characteristics of traditional villages caused by the destruction of environmental resources calls for the attention to return to pursue the essence of traditional village architecture as well as traditional building renovation and environmental coordination. Through the study of the characteristics, craftsmanship and aesthetics of the local materials, the transformation and design of the local buildings with the theory of oriental design are used to show the coexistence of the local customs, architectural characteristics and natural environment. Through the experimental study on the application of local materials in this paper, the design strategy of local materials for the transformation of traditional buildings is summarized to protect and inherit Chinese local buildings, which has a deep developmental significance to the transformation and application architectures in future.

Keywords: Local materials, local buildings, renovation.

1. Introduction
In the rapid development of this information society today, how to use our traditional local materials is an important issue we have to determine. Nowadays, global integration, industrialization, as well as technological progress and technological development have made us gradually become more conscious of traditional culture and Life is lost, and the choice of materials for architectural design is getting more and more attention. Though the renovation of local buildings is also in full swing, our use of design materials is still very chaotic. These are problems that need to be solved urgently.

In the global call for the protection of domestic traditional regional culture, the cultural and local architecture have gradually attracted people’s attention. In order to protect domestic national characteristics and local customs and culture, we will renovate the local materials into the lives of Chinese from the perspective of renovation design to enhance the characteristics of local cultural buildings and allow local residents to germinate the humanistic feelings and emotional resonance of traditional buildings. We hope that the local materials could create scenes that bring local historical events, so as to awaken the memories of local residents, represent their past life experiences and trivial life memories, and give local residents a real sense of identity and belonging to their hometown.
2. Concepts related to local materials

2.1. The concept of local
In the process of Chinese social development, profound and drastic changes have taken place in the Chinese countryside. However, no matter how the local society changes, the living space based on the township will not change, nor will the support for survival based on the soil. In traditional towns, farmers live on the soil and live with the soil. They work at sunrise and rest at sunset, living in the town without distraction. Yunnan Province is located in the southwestern border of China, bordering Vietnam, Laos and Burma. It is dominated by plateaus, with an average elevation of about 2000 square meters. The climate there are subtropical monsoon climate and tropical monsoon climate in a few areas. And it has abundant resources such as plants, animals, agriculture, water energy, etc., with strong local characteristics. This is the concept of local studied in this paper.

2.2. Materials
In our lives, man-made and non-man-made objects are composed of certain materials, which are the basic material guarantee that is indispensable for human development and survival. Therefore, the material is essentially what we make and produce, and can be made into objects. In fact, "material" was divided into two words with different meanings in ancient Chinese. "In 'Analytical Dictionary of Characters', the two words are defined as: 'trunk and measurement', and the original meaning of 'material' is measurement. In the 'Style of Building Method', the concept of 'material' still has multiple meanings, mainly used to specify the cross-sectional dimensions of wood, etc. [1], and play a modular role in the design. Material" is the amount of materials and labor required to control certain costs in the construction process, so ancient Chinese 'materials' refers to a certain amount of building materials."

2.3. Local materials
Local materials are primitive building materials obtained from nature by local people in order to adapt to the environment and meet the needs of life [2]. They are objective reflections of the spontaneously organized production methods and lifestyles in a certain period of time, record the changes in human settlements in different periods, and reflect the relationship between people and people, people and nature, and people and society. The original materials such as soil, wood, stone, brick, tile, bamboo, etc. are all regional local materials [3]. In terms of material performance, compared with modern building materials concrete, steel structure, and glass, it has a deeper cultural connotation and historical precipitation.

2.4. Types of native materials

2.4.1. Timber. Yunnan is a province with relatively high forest coverage in China, and it is also a mountainous plateau province with a diverse landform. Yunnan is known as the "plant kingdom" because of its vigorous vegetation and abundant tree resources. Dali, Yunnan, is full of sunshine, rich in moisture, fresh air and beautiful environment. It is very suitable for the growth of trees and the quality of wood is also very good.

Wood has a profound historical development background in Chinese local materials. From the construction of the most traditional wooden structures to the multi-channel application of modern wooden structures, the use of wood has always been throughout Chinese building construction. Wood has a very wide range of applications in building materials. It can be used as beams to support wall structure, and it can also be used for large-area wooden walls, veneers, floor paving and many other places [4]. Since ancient times, and even in the future, the popularity of wood is closely related to its unique aesthetic and practical value. Traditional Chinese buildings use a rapid assembly system of prefabricated components, and wooden natural materials make it easy to construct, renovate and update [5].
2.4.2. Stone. Yunnan's stone resources rank among the top five in China. Yunnan's natural building stones can be divided into facing stones and ordinary building stones. Marble is the most advantageous stone resource in Yunnan Province, and Dali has been rated as "China's Ornamental Stone City - The Marble City". The stone industry has not only become an important part of Yunnan's ethnic cultural tourism industry, but also an important way to solve the employment and poverty of more people in the Yunnan stone industry chain.

Stone as a local material used in construction has a history of 5,000 years. It is one of the earliest materials we have discovered that mankind has used. Different stones have different characteristics and are widely used. We have used a lot of stone in the history of construction, such as the Egyptian pyramids. Known as the first stone building in the world [3]. In China, it also has the earliest application on city walls. Therefore, for Chinese, stone not only represents a material itself, but also reflects the deep memory of the local regional culture in terms of spirit.

Table 1. Density of common rocks.

| Rock       | Density (g/cm³) |          |          |          |          |          |          |
|------------|-----------------|----------|----------|----------|----------|----------|----------|
| Granite    | 2.52~2.81       | 2.67~3.96| 2.85~3.12| 2.80~3.11| 2.17~2.70| 2.06~2.66|
| Diorite    |                 |          |          |          |          |          |          |
| Gabbro     |                 |          |          |          |          |          |          |
| Diabase    |                 |          |          |          |          |          |          |
| Sandstone  |                 |          |          |          |          |          |          |
| Shale      |                 |          |          |          |          |          |          |
| Limestone  | 2.37~2.75       | 2.72~3.80| 2.72~3.81| 2.72~3.82| 2.72~3.83| 2.72~3.84|
| Dolomite   |                 |          |          |          |          |          |          |
| Gneiss     |                 |          |          |          |          |          |          |
| Schist     |                 |          |          |          |          |          |          |
| Marble     |                 |          |          |          |          |          |          |
| Slate      |                 |          |          |          |          |          |          |

2.4.3. Brick. Mies once said: "Buildings are laid out brick by brick". [6] Brick has been used in construction for thousands of years with a long history and culture. The saying "brick in Qin Dynasty and tile in Han Dynasty are the most famous" has shown that bricks in the Qin Dynasty have been in their heyday. The texture of the brick is very heavy and rich, and the scale is also unified with its own historical atmosphere of traditional cultural heritage [7].

Figure1. Combination of bricks.

2.4.4. Tile. As the earliest dictionary arranged by radicals in China, "Analytical Dictionary of Characters" is explained as: "Tile, the general name of the soil material that has been burned." Duan Yucai noted that "Tile is the burned one. Any soil material that has not been burnt is called the blank, and only burned ones can be called tiles." [8] It can be seen from the paper that tile was first used in soil material products, and then the meaning scope became smaller and smaller. It gradually refers to traditional clay tiles that use clay as raw material applying on the roof of the building. Tile first appeared in the early Western Zhou Dynasty in China, and its application range was relatively small, basically in the area of the roof of the building. In the middle and late Western Zhou Dynasty, roof tiles have been very popular and widely used in Chinese building construction. The Western Han Dynasty was the most prosperous period for burning tiles, and it was known as the "Qin Dynasty's Brick and Han Dynasty's Tiles". In Yunnan, where has many traditional towns the tile resources are basically used in every household.
3. Application of local materials in renovation design

3.1. Renovation strategy
As a special settlement with a large population and a large area in China, the rural area carries unique regional culture and architectural characteristics. On the basis of fully excavating the rural natural scenery, architectural characteristics, and craft culture, the rural area is transformed into a place with beautiful scenery and unique cultural sightseeing, where not only enable tourists to relax and enjoy the beauty of the countryside during sightseeing, but also enhance tourists' understanding of the craft and culture of the rural area by creating corresponding space experiences, and boost the economy, culture and environment of the rural area.

The exploration of local materials at home and abroad has never stopped. People are keen on the application of these natural and mined local materials though traditional construction techniques and construction methods have certain limitations. Under the background of industrialization, contemporary traditional construction methods can be updated and improved with the aid of modern construction technology. I use some transformation methods to explore the improvement strategies of local materials in construction technology.

3.2. Rural integration of native materials
Traditional buildings in rural areas are mostly farm houses and public buildings. These buildings were built using wood, clay, and masonry in a relatively old age. Therefore, some buildings have been seriously damaged and broken, which makes it difficult to meet the demand for sightseeing. However, these buildings as architectures with a relatively long construction age in the town, they still have a high historical value. For these buildings, the rural characteristics can be kept by renovation using local materials such as wood, soil, stone, brick and tile. At the same time, combining some modern building materials, such as glass, steel and other materials to renovate it, so that on the basis of continuing the original architectural characteristics, they would present a unique style through comparison with the new building, and reflects the value of traditional rural architecture in the process of comparing the new and old materials.
3.3. Renovation strategy of wooden structure

Wooden structures have thousands of years of Architectural humanistic history in China, integrating history, art, and science, and have extremely high ornamental value. It is also one of the most important materials in China's local materials.

The traditional wooden architecture system was formed in the Han Dynasty and matured in the Tang Dynasty. The Song Dynasty was further improved on the basis of maturity, and the Ming and Qing Dynasties reached a higher level. In Chinese oriental design theory system, "wood" as the soul has always existed in local traditional Chinese architecture. "Wood" embodies "the great virtue of heaven and earth" in ancient China. From the site selection of the homestead, the measurement of the pillars to the structure of the house, the ancient Chinese all reverently regarded architecture as the birth of natural life, which can better reflect the status of "wood" in Chinese's minds. As a very rich natural local material, "wood" has the characteristics of easy grinding, easy processing, light weight and low density, which is the material prerequisite for selection in traditional Chinese architecture. The texture and color of wood have high plasticity and can be processed to make different modeling effects. In the "Style of Building Method" in Song Dynasty, there are rich and diverse ancient wood materials, each with different scale relation, and unique places where they are especially used.

Table 2. Example table of bressummer materials in "Style of Building Method" of Song Dynasty (Unit: Song Chi, 1 Song Chi = 3.168m).

| Name             | Length | Wide or diameter | Thickness |
|------------------|--------|------------------|-----------|
| Hackberry pillar | 30     | 2.5~3.5          | —         |
| Pine pillar      | 23~28  | 1.5~2.0          | —         |
| Admixture lumps  | 60~80  | 2.5~3.5          | 2.0~2.5   |
| Thick lumps      | 50~60  | 2.0~3.0          | 1.8~2.0   |
| Long lumps       | 30~40  | 1.5~2.0          | 1.2~1.5   |
| Pine lumps       | 23~28  | 1.4~2.0          | 0.9~1.2   |
| Small pine lumps | 22~25  | 1.2~1.3          | 0.8~0.9   |
| Mostly used lumps| 16~27  | 0.8~1.2          | 0.4~0.7   |
| Official lumps   | 16~20  | 0.9~1.2          | 0.4~0.7   |
| Truncated lumps  | 18~20  | 1.1~1.3          | 0.75~0.9  |
| Wooden sub-lumps | 16~18  | 1.0~1.2          | 0.6~0.8   |
| Square lumps     | 13~15  | 0.9~1.1          | 0.4~0.6   |
| Official 8 lumps | 13~15  | 0.6~0.8          | 0.4~0.5   |
| Lumps with 8 sub-lumps | 12~15 | 0.5~0.7          | 0.4~0.5   |

In the use of local materials, the wooden structure can break the limitation of its own size and is not restricted by standardization. It fits flexible design and can be simple and convenient structure renovated, which can allow the design be more imaginative and having free design space, which is conducive to the realization of various shapes, innovative design. In the construction process, the position of the structure and the layout of the space can be adjusted flexibly, which is easier to renovate and expand than the reinforced concrete structure. In the design of the Bonan ancient Road workshop in Yangbi, through the protection and repair of the traditional wooden structure, and the integration of the new wooden, the concept of "wood" has been surrounded in the design, maintaining the original rural characteristic while performing different functions. Different wooden structures are used in different functional areas in order to respect the tradition, renovate the building, and create a rural atmosphere.
3.4. Reconstruction strategy of stacking stone structure
The stacking method is more commonly used for the stone, which is to use the scattered stone, through a certain regular combination and reorganization, in the vertical direction, according to the way of stacking, build layer by layer. This method allows stone to withstand the load and weight from the upper part through its own strength.

In the design of homestays, my design uses local natural stones of irregular shapes and sizes to build part of the house, and uses clay as the adhesive between the stones. Innovate in the original local construction, reduce the height of the stone wall, integrate wood and curtain walls, and innovate the architectural form to solve the problems encountered in lighting and ventilation, and integrate with the rural characteristic. The use of local stone materials, local materials, saving transportation costs, and remaining the cultural characteristics of the town, different sizes of stones make the texture very rich, highlighting the local customs created by the local materials.

3.5. Renovation strategy of brick structure
There are many ways of brick masonry, and different combinations and architectural forms will present different facade effects and overall effect. The masonry of bricks is based on the mechanical performances of the material itself, through the basic masonry layering and lap joints to achieve the
final architectural goal [9]. Bricks have different masonry methods, and the vertical, horizontal, and diagonal relations that it brings let us know more about the way of handover in the construction process. While showing the construction craftsmanship, bricks can also convey profound cultural connotations [10]. The same is true for tile masonry. According to different arrangements and combinations, it can also be combined into a variety of forms. In the renovation design of the Tea Culture Experience Center on Bonan ancient road in Yangbi, the local blue brick materials are used to combine the facade and internal structure into different forms through different arrangements, creating different communication in spaces and light and shadow relations. Most of the walls of the building also use local blue bricks, and tile materials are integrated in the details to echo the roof and organically integrate with the entire traditional local architecture.

Figure 6. Analysis of the use of local materials in Tea Culture Experience Center on Bonan ancient road in Yangbi.

4. Conclusion

Local materials are derived from nature. We hope to reshape Chinese residential environment with local culture through the integration of local materials and rural architecture to get close to the nature. We apply the theory of Oriental design to the design of rural renovation. While respecting Chinese natural ecological foundation, we also combine local humanities and regional culture to achieve the purpose of revitalizing local architecture. The renovation and application of local materials in architecture is a product of material culture in the development of Chinese society. It protects the regional culture of the local while adapting to the contemporary social development, and can be promoted and developed in protection and inheritance of traditional architectures. I hope that the study on local materials through this paper can have a deep developmental significance for the application of renovation design in the future.

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