

Material Analysis of Traditional Folk Dwellings and Its Modern Inheritance: A Case Study of Traditional Folk Dwellings in Hunan Province

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Abstract Traditional folk dwellings contain rich cultural connotations and plain architectural techniques. In architecture, material is the most fundamental thing, different materials can demonstrate different architectural forms, and reflect local characteristics and change of the time. Therefore, it is of great significance to explore the material selection of traditional Chinese folk dwellings. The paper took traditional folk dwellings in Hunan for example to analyze the regional materials and construction of these dwellings, discussed the application of traditional materials in modern architecture, used some cases to explore the innovative application of traditional materials, so as to figure out the new direction of applying traditional materials, and provide references for the construction of modern architecture.

Keywords Traditional folk dwellings, Building materials, Hunan

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Traditional folk dwellings are carriers of traditional cultures and regional cultures, and also manifestations of a region's development characteristics and unique cultural traditions. With dominant regional features and profound historical accumulation, traditional folk dwellings show the adaptability of mankind to the natural and social environment in different periods^[1]. Both form and material of folk dwellings reflect local natural environment, history and humanistic background of a region, have high aesthetic value and social significance. Traditional building materials have developed steadily for human wisdom. With the constant development of social economy and modern people's awareness, traditional folk dwellings have gradually turned from natural to artificial, and become a kind of unique form adaptive to local geographical and humanistic environment. Folk dwellings in the Ming and Qing Dynasties were not as rigorous and splendid as royal buildings, but they reflected the realistic life of people, and contained profound humanistic background. Through investigating folk dwellings in traditional settlements, local political, economic and cultural conditions of the time could be better known. This paper took traditional folk dwellings in Hunan Province for example, explored the material selection of traditional folk dwellings and the application of traditional materials in modern architecture.

1 Research area

Hunan Province is located in south of the Dongting Lake, embraced by mountains in southeast, northwest and north, its terrains are low and flat, mostly covered with mountains.

Influenced by continental subtropical monsoon humid climate, the local area has windy and cold winter, and long humid and foggy summer^[2]. Material selection for traditional Chinese dwellings basically follows the rules, specifically, local natural conditions, unique historical and humanistic environment, living habits of the local people as well. Moreover, local terrains and climate are fully considered to determine the shape and layout of dwellings. Therefore, traditional folk dwellings in Hunan are mostly built with timbers, stones and bricks.

2 Material selection and construction of traditional folk dwellings

Traditional folk dwellings show 2 outstanding characteristics, practical and economical. Most of them use timbers and earth, and some choose artificial bricks and tiles^[3]. In this process, all materials blend and mutually restrict, finally form a sound system, showing the developed production mode of Chinese ancestors, and maintaining their specific cultural and artistic rhythm.

3 Application of traditional materials

Natural materials can not only meet the living needs of people, but also are good for the environment.

3.1 Timbers

Most of traditional Chinese buildings are made of wooden structures, because timbers perform well in crush resistance, workability, and earthquake resistance. Timbers are mainly used as the framework, and the traditional wooden

structures include post-and-lintel construction, log-cabin structure, column-and-tie construction, and stilt style.

Folk dwellings in Hunan are mainly post-and-lintel and log-cabin structures (Fig.1), affordable and pretty. For the geographical environment and humid climate, local dwellings choose bigger frameworks to facilitate the air flow^[4]. Buildings easily crack and get rotten because of high humidity, thus local buildings need reinforcement and getting rid of dampness, most of them choose vent on the roof to accelerate the indoor ventilation^[5].

3.2 Earth materials

Application of earth materials can effectively reduce the indoor humidity, showing high practicability and thermal performance. Earth is rammed tightly layer by layer to make rammed earth bricks. Meanwhile, it provides a natural dampness-proof or waterproofing method, i.e. covering the adobes with a layer of clay to make it absorb no or less water. Earth materials not only can absorb moisture from indoor air and make a relatively drier indoor environment, but also is good at resisting against moisture (Fig.2). As the earth consistently absorbs moisture and the moisture evaporates, salt transfers to the earth surface after being separated from soil, so the soil stability is improved. Rammed earth wall performs well also in fireproofing and heat insulation, and soundproofing for the high-density compact rammed layer. Surely, the rammed earth softens in case of high humidity and easily cracks, thus rammed earth reinforcement is extremely important. It is effective in reducing cost, preventing seepage, protecting original structure, and enhancing

strength and stability. For these traditional folk dwellings, using earth materials to fill in the walls was a good option though in those days^[6].

3.3 Stones

Stones are good at waterproofing and have high hardness, but in the olden days, quarrying and transporting of stones were much difficult, thus they were seldom used in folk dwellings. The high hardness and toughness of stones make the buildings more stable and safe^[3]. Most folk dwellings in Hunan have earth bases, and use mainly the local soils, they are vulnerable to water erosion. On the contrary, stone base can support the whole structure, and perform much better in avoiding moisture erosion (Fig.3). Moreover, stones on the walls and grounds can be carved with diversified patterns.

Lahao Yingpan Village in Hunan is a typical stone village, because stones in the village are abundant and easily collected, most of the buildings in the village are made of the local shale sheets, these stones are used to make not only walls, but also roofs, steps, and city gates (Fig.4). These tough stones are excellent defensive materials and also good tools to resist against wind and sand. The attractive force and friction between stones are well used to enhance the stability of walls. The thick stone walls perform well in insulating heat, delaying the transfer of outdoor temperature to the indoor, thus these buildings are cool in summer and warm in winter^[7].

3.4 Bricks and tiles

Bricks and tiles are both made of baked earth, they are highly durable. Various masonry methods can be used to make brick walls, for example, the textures of walls can be better displayed by combining horizontal and longitudinal brick laying, and also hollow tiling can be made. In Zhanguyue Village, most of its ancient buildings have solid grey brick bricks (Fig.5), those bricks are made of local earth, all gaps on the wall are horizontally flat, pretty and practical, good at heat insulation in winter. In summer, the indoor temperature is lower than the outdoor, and even the internal and external wall temperature is lower than the outdoor. Therefore, application of bricks and tiles is economical, convenient, and also helpful for improving living environment^[8].

Hunan is cold in winter and hot in summer, rainy all the year round, thus all roof tiles need to be good in waterproofing and heat insulation. For the traditional buildings in Zhanguyue Village, those double-layer green tiles are solid and extremely efficient in waterproofing and heat insulation (Fig.6). Temperatures on the top

tile and bottom tile were measured respectively, the maximum temperature on the external part of the top tile was 72.5 °C, and that on the internal part of the bottom tile was only 45 °C, the temperature difference was as high as 27.5 °C, which showed its excellent heat-insulating effect. Moreover, the temperature on the single-layer grey tile roof quickly dropped to 25 °C at night, showing the significant heat-reducing effect of these grey tiles at night^[8]. The tiles are arched, relatively flat or semi-cylindrical, most of them are grey-black or black, but some are red, blue and purple. In Feiyue Village, the grey tiles are mainly arched, and actually are not grey in color, but dark blue and grey blue^[9].

4 Inheritance and development of traditional materials in modern architecture

Form and material selection of traditional folk dwellings can be enlightenment for modern architecture, modern architectural design should not only choose materials suitable for modern buildings, but also fully consider history, culture and natural conditions of the local area, and reflect characteristics of the local area^[10]. Ancient buildings in many regions have been badly destroyed for various reasons, they all need reasonable planning and design to be well preserved, so that their functions can be better manifested, and more attention should be given to the innovation of materials and techniques to avoid damages. Therefore, some traditional elements can be introduced into the architectural design to present buildings adapting to the local characteristics in the new era, and ensure the safety and stability, which are the rules to be followed in the architectural design.

For traditional building materials, detailed designs of various textures require the improvement of both material quality and construction standard, the designs should be transferred from “extensive” to “refined”. The organic combination of traditional building materials and modern materials is not only a kind of inheritance, but also an innovation of traditional folk dwellings.

Traditional materials blended with new techniques show brand new textures, colors and other changes, which certainly bring the traditional buildings different images. Meanwhile, the new techniques help optimize the properties of traditional building materials, expand the application field, bring new vitality to the traditional materials, so these traditional building materials are not only a symbol of traditional culture, but also a tool of showing the artistic

expressive force of modern architecture^[11].

4.1 Timbers

Modern building materials have higher hardness, while timbers have lower hardness but higher toughness, so both of them can be integrated according to the actual needs. For example, Hanzhou Southern Song Imperial Street Art Gallery is consisted of multi-story folding wooden-roof sunshade, the style is based on the wooden arch structure of ancient gallery bridges in ancient south Zhejiang, and for some parts of it small steel beams are hidden to make the whole structure span less, use fewer materials and supporting points, build a kind of powerful, curved and dynamic roof, and make Zhongshan Road more beautiful. As tourists go in from the entrance, they can feel the strong visual shock brought by the continuous woven archway. The application of such wooden archway (Fig.7) shows the correlation between modern wooden buildings and traditional architectural cultures in form^[12].

4.2 Stones

Fushanchun Art Gallery is the first public building design work of Wang Shu after he won The Pritzker Architecture Prize, the design intention is to keep the “originality” of the building. The surface structure uses the local characteristic chipped tile-brick wall technique (Fig.8), adopts mainly natural unpolished stones, tenon joints, and the combination of stones and cement. Because stones are natural and not intentionally planned products, these stone walls show a vivid “natural style”. The roof chooses stones and reclaimed bricks, the design of scenic corridor enables visitors to get close to the stone roof. In this building, stone is no more a structure of a building as it was in the traditional buildings, it turns to be a surface material and loyally reflects its efficiency in maintaining the structure and visual effect^[13] (Fig.9).

5 Conclusion

Modern buildings are not completely divorced from traditional buildings, both of them are mutually supplementary and can promote each other. Traditional buildings enrich the modern architectural design, and fully demonstrate modern people's demands on the cultural connotations of buildings, only when the traditional architectural elements are well displayed, can the traditional Chinese culture be well inherited^[14]. Compared to modern buildings, traditional folk dwellings are products more adaptive to natural conditions, and results of the mankind's reform of natural environment for a long time. During the construction of traditional



Fig.1 Wooden structure of Shen's Grand Courtyard



Fig.2 Rammed earth buildings in Shen's Grand Courtyard



Fig.3 Stone base in Laojiazhai Village, Fenghuang Ancient City



Fig.4 Location of stone application in Lahao Village



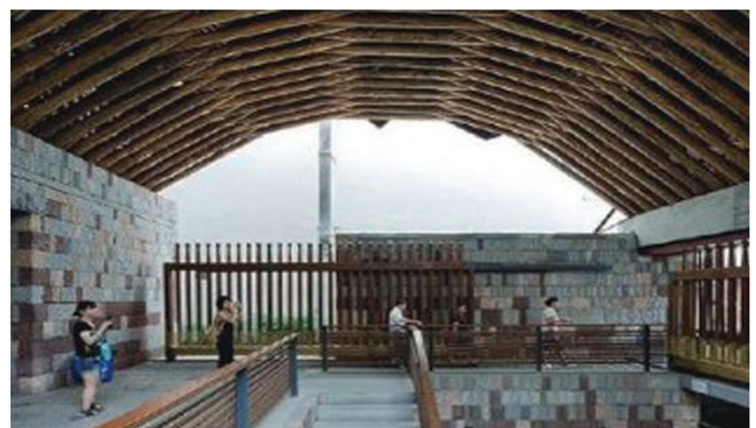
Fig.5 Grey bricks in Zhangguying Village



Fig.6 Grey tiles in Zhangguying Village



Fig.7 Rainbow-shaped bridge and Imperial Street Museum



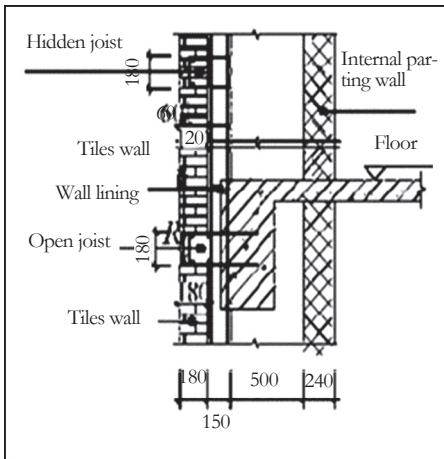


Fig.8 Chipped tile-brick wall structure



Fig.9 Fushanchun Art Gallery

folk dwellings, all the selected materials contain the traditional construction techniques and thoughts, which is a kind of man-nature harmony. However, as the time goes by, the lifestyle and production mode of modern people have witnessed great changes, thus traditional folk dwellings also have experienced development and promotion, and in this process, better construction techniques would be invented, and more suitable construction materials be found^[15]. In addition, learning traditional folk dwellings helps us to figure out new modern buildings more suitable for the inheritance of regional cultures and development of the times.

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