

Research on Protection and Maintenance of Traditional National Architectures in China

----- A case study based on Qiang Village

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ABSTRACT

As the traditional architecture of the Qiang Nationality, Qiang Village is an important component in studying ancient buildings of minorities in China. Unfortunately, traditional architecture of the Qiang Nationality has been damaged seriously by natural disasters. Moreover, people have inadequate understanding and protection to aesthetic value and cultural connotations of traditional architecture of the Qiang Nationality in the rebuilding process. In this study, characteristics of traditional architecture of the Qiang Nationality were analyzed, absent contents in its development and relevant causes were investigated, and traditional maintenance technologies were summarized. Moreover, current new technologies for maintenance of ancient architectures were introduced and some technological suggestions to protection and inheritance of traditional architecture of the Qiang Nationality were proposed to offset disadvantages of traditional technologies. This study is expected to provide supports to protection and development of ancient architectures of minorities in China.

Keywords: *Qiang village, architectural features, national culture, rebuilding, repair, GIS BIM*

1. INTRODUCTION

Locating in northwest region of Sichuan Province, the Aba Tibetan and Qiang Autonomous Prefecture is an important region to understand cultural heritage of the Qiang Nationality and the only one Qiang autonomous prefecture in China. It lies in the residual mountains of the Qinghai-Tibet Plateau and there are many alpine and gorge regions. Traditional residential buildings of the Qiang Nationality originated from the Neolithic Period and they have a history of more than 5,000 years. Existing traditional architectures of the Qiang Nationality still maintain the primitive simplicity and they mainly distribute in Mao County, Wenchuan, Li County and Beichuan. In history, ancient Qiang people put survival and safety first in choosing sites of villages. Therefore, the upper reaches of the Minjiang River become the best place for hiding and survival because of local complicated geographical environment. The ancient Qiang people made reasonable use of local geographical conditions, thus forming present characteristics of Qiang Village in harmonious integration with mountains. Traditional architectures of the Qiang Nationality have thick regional characteristics. They are characteristic of elegant appearances, rigorous internal layout and high attentions to materials. Traditional architectures of the Qiang Nationality are built with local stones which have sculptures of local characteristic patterns and have rich aesthetic cultural connotations. They are one of extremely representative cultural features of the Qiang Nationality and an important component to study ancient buildings of

minorities in China. In this study, architectural characteristics of the Qiang Nationality and challenges against its further development are discussed, and some new technologies for maintenance and rebuilding are proposed to promote protection and inheritance of the Qiang Nationality

2. CHARACTERISTICS OF THE QIANG VILLAGE

2.1. Characteristics of architectural complex in the Qiang Village

In view of general appearance of traditional architectures of the Qiang Nationality, they are built with local stones and earths near mountains, which lower the construction cost.



Fig.1 Geographic layout of Qiang Village

(Image source:

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In the Qiang Village, houses are connected and external walls are made of local pebbles and rubbles, forming mottled patterns. There are piles of white stones on all four exposed corners of houses, which look like four ears or four horns of the house (Fig.2). These white stones on the roof are for not only decorations, but also original religion. According to the legend, ancestors of the Qiang Nationality fight with foreign people in ancient times and saved by the Baishi God when they were hopelessly outnumbered and faced with the critical moment of survive or perish. Worship to the Baishi God has been popular in the Qiang Nationality since then[1].



Fig.2 White stone decorations on roofs

(Image source:

https://timgsa.baidu.com/timg?image&quality=80&size=b9999_10000&sec=1591883466286&di=6c91442f8285eac991730a745e55444d&imgtype=0&src=http%3A%2F%2Fs6.sinaimg.cn%2Fmw690%2F6d04a6eegx6Cy2N4goR75%26690)

In the village, there are interweaved lanes and different houses are connected. Watchtowers for war defense and public sacrifice activities and residential buildings have different heights and explicit layers, which gives the whole Qiang Village a sense of majesty of fortress architecture (Fig.3).



Fig.3 Overall morphology of the Qiang Village

(Image source:

https://timgsa.baidu.com/timg?image&quality=80&size=b9999_10000&sec=1591883894915&di=aec40447aae37c2b18759a49d16a7fb9&imgtype=0&src=http%3A%2F%2Fimage.naic.org.cn%2Fuploadfile%2F2018%2F0420%2F1524201613043766.jpg)

Due to climatic impacts at upper reaches of the Minjiang River, the ground floor of residential buildings in the Qiang Nationality is not as open as those of stilt style architecture in southern China, but it is enclosed by rocks. The closed walls not only strengthen the bearing capacity, but also have defense functions. However, there are poor lights in indoor spaces due to the few windows. The vents are designed as cones with larger size inside and smaller size outside. Open kitchen is adopted, which caused poor air quality indoor since cooking fumes cannot be discharged timely.

For a single building in the Qiang Nationality, it has a trapezoid appearance, large at bottom and small at upper. Since internal structure and functions vary from household to household, there are different number of floors (3~5 floors) of the same building at different positions.

The first floor is mainly for storage and livestock, and some may have toilets.

The second floor is the center of the whole building and the core of residential culture. According to use functions, the second floor can be divided into master bedroom, guest rooms, fireplace (a small pit dig on the indoor ground and surrounded with masonries. Fires are made in the pit for heating and cooking), shrine and kitchen. The plane layout is arranged by centering at the fireplace (Fig.4), which fully reflects religious culture of the Qiang Nationality and adapts to production and life demands of the Qiang people[2].



Fig.4 Internal space of the second floor in Qiang Village

(Image source:

https://timgsa.baidu.com/timg?image&quality=80&size=b9999_10000&sec=1591883639487&di=8900985b72ce34966009bee04bdf022&imgtype=0&src=http%3A%2F%2Fimg.mp.itc.cn%2Fupload%2F20170108%2F1f72582edde547ee962797f7211727be_th.jpg)

The third floor is an interlayer. Because of the fireplace in the second floor, the third floor has an empty space above the fireplace to storage smokes.

The fourth floor is mainly for storage. Since smokes from the fireplace can rise to the fourth floor through the third floor, it is mainly used for air-curing of preserved meats and other foods.

The top floor is an open platform or tower with three closed walls, but opens on the south. The floor area is only 1/3 of the whole roof area. The tower is the place for sun bath and rest of Qiang people and it also can be used to air-curing and storage of foods and sundries for a short period.

2.2 Characteristics of watchtower in the Qiang Village

Watchtower is a very typical building in the Qiang Village. It was firstly built for military defense and the central building and visual symbol of the Qiang Village (Fig.5).



Fig.5 Watchtower in the Qiang Village

(Image source:

https://timgsa.baidu.com/timg?image&quality=80&size=b9999_10000&sec=1591883740906&di=9cbc0380961ddf49bbc809fc881b816d&imgtype=0&src=http%3A%2F%2Fimage.naic.org.cn%2Fuploadfile%2F2018%2F0112%2F1515734771816363.jpg)

With respect to specific material selection, the abundant rocks and yellow muds on mountains are used fully. The whole building is wide at bottom and narrow at top and the stone walls are thinned gradually from bottom to top. The external wall includes inward slightly and it shrinks significantly in the upper position, while the inner wall is still perpendicular with the ground. In the building process of watchtower, a long wood has to be embedded into walls when it is built to an appropriate height. Such organic structure not only serves as wooden support during construction to make the watchtower extend vertically continuously without tower crane, but also is convenient for flooring in future and provide connected fixation of the whole watchtower. There's a stone ridge behind a high watchtower as the support framework that runs through the whole structure. Such pyramid structure (wide at bottom

and narrow at upper structures) and unique connection structure determine the sturdiness of the watchtower in the Qiang Village and make it be able to be kept completely in earthquakes compared to surrounding buildings.

With respect to space and functional layout, watchtower is not isolated. The watchtower has a main characteristic that it is connected to ordinary houses. External walls of the watchtower have no doors and the internal space is connected with spaces of residential buildings. The upper building is only accessible from residential building. Take two famous watchtowers in Chenjia and Wenjia in the Taoping Qiang Village for example. These two watchtowers are right behind the village and have hills in the back. They are the visual center of the whole village and surrounded by residential buildings at the right and left. The watchtower has 9 floors (245m) and all four walls in each floor have holes which are called bucket windows. The bucket windows are small at outside and large inside. These bucket windows are good for lighting and can be used as ports during war, and also can prevent external shots effectively. Among existing watchtowers in the Qiang Village, some watchtowers have semibasement for storage and shelters during war. Some even have small exits that connect with sewers, blind pass and main channels, which can be used as the escape way to the outside during war[1].

3. CULTURE LOSS OF THE QIANG VILLAGE

Cultural loss of the Qiang Nationality includes material and spiritual cultural losses. In this chapter, the absence content of architecture which is represented by the Qiang Village and relevant reasons are investigated.

3.1 Absent contents

On the one hand, the survival environment has been changed and the impacts of war diminish gradually with the economic and social development. The Qiang people have no concern of defense, and they have reasons to build the traditional watchtowers and stone houses. The underground maze formed by blind passes of different households loses the value of existence and these underground channels are blocked gradually. On the other hand, the traditional charm of architectures of the Qiang Nationality declines in the transition from mountain areas to plains, which is attributed to the significant influences of the Han Nationality on the Qiang Nationality in Beichuan. For instance, there are stilted wooden buildings in the Xiaozhaizigou of Beichuan. Although many houses in the Qiang Village are made of stones, most of them have Han-styled roofs and even red tiles. The original buildings will disappear in the modern society gradually when its symbolic meaning is lost and it fails to gain a continuous functions[3].

3.2 Main reasons

Firstly, traditional residences in the Qiang Nationality are in the Longmenshan fault zone where suffers great earthquake damages. Secondly, traditional residential buildings in the Qiang Village have poor anti-seismic properties for the material uses and original technology. For material selection, traditional residential buildings in the Qiang Village are mainly built with yellow mud and green rubbles. Wood is the main materials, while yell mud, sands or sticky rice pastes are used as the binding materials, resulting in the low strength of bonding materials and short service life. For construction technologies, these buildings are rammed-earth houses formed by piling of irregular stones and earths, with reliable joints between walls, between walls and components, and between components. As a result, the house has poor integrity and anti-seismic properties. In addition, foundations are buried superficially, without preserve of appropriate settlement joints. Using small stamping stones as the foundation lowers integrity and rigidity of the foundation. Finally, with economic development and continuous Chinesization, the recognition degree of Qiang people to the meaning of traditional buildings decreases, which is one of important causes of cultural loss of the Qiang Nationality.

4. REBUILDING AND MAINTENANCE OF THE QIANG VILLAGE

With increasing attentions and guidance of government to rebuilding and maintenance of traditional buildings in minorities as a response to economic and cultural development in China, scientific researchers and the public began to pay more and more attentions to protection of traditional buildings. In this section, rebuilding and maintenance of the Qiang Village are discussed from traditional maintenance technology and new technologies.

4.1 Traditional maintenance technologies

Traditional maintenance technologies are main inheritance of traditional materials and traditional skills: 1) using previous local materials, and 2) making temporal repair of details of the building with traditional skills. Materials for traditional repair all can be collected in local areas, such as yellow mud and rubbles. Yellow mud can be collected by digging for 0.5m, which has good viscosity and strong self-healing performances. Rubbles on high mountains are generally calcium carbonate and quartz which are hard and have strong tolerance. They can form indestructible structures together with yellow mud. After mixed with water, the yellow mud is blended with stones and bamboo branches. The mixture is filled in the model which is formed with two wooden plates and then compacted with a

mallet.

However, such earth-rammer construction incurs significantly labor cost nowadays. Building which use stone and wooden materials only will influence ecology. Buildings in traditional form and structures are difficult to adapt to current production and life mode of villagers. Hence, opportunities to construct traditional buildings in villages decline gradually. It is urgent to develop new technologies for repair and rebuilding of the Qiang Village.

Traditional repair technology is effective to repair details of buildings to some extent, but it still has great limitations. Nowadays, construction workers are making new explorations continuously in recent years to offset shortages of traditional technologies by using new technologies.

4.2 Modern new technologies

Different from traditional repair technologies, modern technology is characteristic of integral and dynamic. Currently, the repair and rebuilding process is more intuitive and accurate by combining BIM and GIS.

According to the original data, BIM model is mainly constructed by two methods. The first one is to build a BIM model according to design drawings and construction in the design stage. It is often used in construction of modern buildings. The second one is to make three-dimensional modeling based on data of existing buildings. This is often used to ancient buildings which have no design drawings or cannot acquire accurate data because of long-term deformations. Rebuilding and repair of the Qiang Village adopts the second method[5].

However, protection of ancient buildings is a long-term and dynamic process which requires dynamic control and adjustment. The holographic geometric model based on three-dimensional digital technology manages the peripheral geographic environmental information of ancient buildings through GIS. The object-oriented parameterized model based on the building component level which is constructed through BIM technology has been applied to protection of some ancient buildings in the world. It will provide a technological support platform for daily protection and management of the Qiang Village, deepen and perfect protection and management of the village, and realize dynamic and real-time management and controls. The specific applications are introduced as follows:

a. Information inquiry

Managers can set up an information system for protection and management of Qiang Village through GIS for the purpose of fast inquiry of relevant buildings and display attribute data of buildings. Meanwhile, it can provide relevant documents for processing and future planning of each building. In the same platform, patterns and image information at present and in future planning can be inquired quickly.

b. Dynamic monitoring

For real-time understanding on buildings of the Qiang

Village, managers can investigate all buildings in the village within a certain period and thereby collect information in different periods. On this basis, dynamic management and control over buildings in the Qiang Village can be realized through the GIS system.

c. Information exchange

Government sectors can display analysis results, protection zones and the latest news of protection policies, communicate protection strategies with residents in the Qiang Village, and promote cooperation with local minorities through the GIS.

d. Formulation of plans

For maintenance and protection of valuable buildings in the Qiang Village under limited budgets, architects and planners can divide each building into different components through data in the GIS, such as ground, foundation walls, roofs, and indoor decoration, comprehend conditions of each component, and recognize priority level of protection and maintenance of buildings. The priority level which is formed according to authenticity and conditions of different components of the building is applied to formulate plans of protection and maintenance and promote the general regional development[6].

5. CONCLUSIONS

In this study, a comprehensive analysis on architectural characteristics of the Qiang Village and material and cultural loss is carried out. Key attentions are paid to protection and rebuilding technologies according to absent contents. Based on analysis of traditional technologies, it concludes that traditional technologies have some shortages, including insufficient systematicness, insufficient integrity and excessive rely on local materials. To address these problems, the modern BIM and GIS technology are introduced, aiming to provide a digital platform integrated with diversified data. This platform can improve scientificity and comprehensiveness of planning of the Qiang Village and realize dynamic management of the village. On the one hand, it can provide assistances to decision-making on cultural resource protection and social economic development of minority villages. On the other hand, it provides real-time data sharing and data statistics of drawings of the Qiang Village and expands the architectural database of the Qiang Village continuously. These are conducive to realize researches and practices of digital protection for ancient buildings under big data environment. However, it is important to note that modern new technologies still have spaces for progresses and they have some limitations in practical applications. For instance, there are few people mastered the new technologies and there's no special training department, thus resulting in the slow population of technological applications. In future applications, further deep studies are still needed to improve professional level of technicians and the department.

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