Study on the protection and renewal of residential houses rooted in traditional geo-industry
Take Shangyangxi Village, Dali, Yunnan, China as an example

Chen Zhang 1*

1College of architecture & urban planning, Shenzhen university, Shenzhen, Guangdong, 518060, China
*Corresponding author’s e-mail: daleychen@foxmail.com/354816231@qq.com

Abstract. The author conducted a three-week survey of the industrial structure, residence and minority culture of Shangyangxi Village in Dali, Yunnan. Focusing on the research and protection of a “Bai” traditional building with a century-old “three wing houses and a screen wall” style, a certain degree of commercial and residential renovation of the building was taken so as to meet the actual needs of households. As for this design, the author relied on the location of the village, the architectural characteristics and the subjective requirements of the household to complete the repair of the house and to update the function on the technical and design perspectives. This design not only provides an example for the renovation of other Bai traditional buildings, but also provides a different approach to village-renovation in the future rural planning and heritage protection. Bai dwellings should be protected according to the different characteristics of the village and adapted to the local conditions, giving the traditional buildings a new function and life.

1. Introduction
Dali is located in the southwestern frontier of China- Yunnan Province, with a plateau about 2000 meters above sea level. Since the Subtropical plateau monsoon climate is dominant, the temperature difference between the four seasons is quite small. The population here is dominated by the Bai nationality. Culturally, Dali is at the junction of the Central Plains, Southeast Asia and the Qinghai-Tibet culture circle. Therefore, Dali culture has been influenced by the culture of Diqiang, Baipu and Baiyue culture, and on the basis of which, Dali has developed a unique “Bai” culture [1].

Shangyangxi Village is located in Wanqiao Town, Dali. In the urban industrial planning, because it is 28 kilometers away from the city and away from traditional tourist villages (see figure 1), it was classified as an ecological agricultural village. In recent years, the traditional farming and business model is still maintained, which is the living cultural heritage that the village needs to protect, and also is industrial economic foundation which constitutes and supports the future development of the village.

At present, the buildings in Shangyangxi Village are mainly composed of simple two-storey brick houses, and the architectural style is mostly the traditional “Bai” building style. With the enhancement of the economic level of villagers and the popularization of new technologies, most of the new houses in the village have been adopted modern materials and technologies. As a result, the proportion of buildings with traditional Bai features have been lower.
2. The industrial structure and residential situation of Shangyangxi Village

2.1. The historical development of Shangyangxi Village
Shangyangxi Village is located at the foot of the Lotus Peak of the Cangshan Mountain, which is covered by snow in all seasons. The terrain here is relatively flat. Yangxi stream, which was formed by the melting of Cangshan snow, passing through the village, and is the main source of agricultural and daily water supply in Shangyangxi Village. Since about the 6th century, Shangyangxi Village has been a place which has the fertile land and living conditions. As of 2012, the village had a population of 2,683, of which 2,592 are agricultural population. The per capita annual income of farmers was about 9000 RMB, which indicates that the place is a relatively impoverished area [2]. Field research found that with the increase of population and the continuous decline of water level. The construction period of buildings in the village showed an increasingly new trend from west to east; the houses have been gradually expanded from the foot of the mountain to the lakeside. This can be seen as a dynamic process in which the ecological environment is constantly squeezed by living and production spaces as the climate changes.

Since ancient times, the Dali area has been closely related to the Central Plains of China in politics, culture and economy. Therefore, on the basis of the national culture, the Bai culture shows a typical characteristic of the Central Plains culture. There are many historical sites in Shangyangxi Village, for instance, the “Duanzongbang” temple built in the middle of the Qing Dynasty, as well as the Raksha Pavilion with hundreds of years of history. In the folk custom, the temple built on the boulder in Cangshan is used to suppress the ghosts on the mountainside. Every year in the “Benzhu” festival, the ritual team will walk through the stone bridge which is a century-old from the village to the temple to worship their ancestors. Moreover, some historical buildings which are nearly one hundred years in the village are extremely well preserved [3].

2.2. Population and Industrial Structure
There are 626 households in Shangyangxi Village, and the ratio of male to female is relatively balanced; the working population is 1,473, of which 431 are engaged in agricultural production [3]. With the rise of migrant workers in recent years, more young people who are under 30 years old leave their hometowns to big cities for more working opportunities. As a result, the phenomenon of aging in the village has begun to stand out. At present, Shangyangxi Village is still a typical agricultural-led natural village. The secondary industry in the village is small in scale and is mainly produced by small workshops. Meanwhile, the structure of the tertiary industry is simple, where there are only basic types such as weekend fairs or small shops. In the past decades, the crop industry dominated by cash crops
such as garlic, which is the pillar industry of the village, accounting for about 40% of its total economic income [2]. Every year when the harvest season comes, there are many businessmen from all over the country coming to investigate and negotiate the business with local farmers. They often stay near the village for a few days until the garlic was loaded and shipped away. The garlic processing infrastructure in this village is rare, and the production and marketing model is single because it is only capable to process and to sell the raw materials. Therefore, the new type of agricultural village that integrates sightseeing and experience will greatly enhance the agricultural production standard of this village.

2.3. The characteristics of traditional houses
In Shangyangxi Village, the most traditional residences of Bai ethnic are the Bai buildings, which consist “three wing houses and a screen wall” (see figure 3). This is a typical enclosed building with an average construction area of around 400 square meters. The basic pattern of the courtyard is three wing rooms, where there are three rooms per floor and two floors in each side, while the other side is a white wall. On the one hand, the wall can block the strong wind blowing from the Erhai Lake, and on the other hand, it can reflect the sunlight into the dark courtyard at evening. The main wing (west side) is mainly for the elders to live in, where the upper level is dedicated to the ancestral tablets, and the depth and height of main wing are greater than the wings of north and south. On both sides of the main house, there are two "leakage angle" with two floors, which are used as auxiliary functions. There is a patio in front of the leakage angle for ventilation and plantation. The bathrooms of traditional houses are usually in the courtyard with poor conditions and they are almost temporary. It is notable that this type of building has a big courtyard with galleries. In Dali, where the winter is warm and summer is not very stuffy, these spaces are very suitable for the mass production and living activities of the residents, such as eating, banqueting, drying laundry and handicraft production. Therefore, in the protection and renewal of the entire village, architects should focus on the spatial characteristics of these vernacular dwellings to ensure that the completed renovation works can protect the core values of residential buildings.

Figure 2. Part of the Shangyangxi Village Building Classification Map, Source: Author Self-painting.
3. Development Status and Protection Dilemma of Shangyangxi

3.1. Existing characteristics of agriculture and development dilemma
At present, Shangyangxi Village adopts a planting development model based on garlic and supplemented by other cash crops. Every year in February and March, a large number of garlic merchants will come to the village to check the growth of garlic and negotiate about the business intention with the farmers. In April, these merchants will return to complete the transaction with the farmers. Garlics that have been processed preliminarily or unprocessed by the farmers are transported by road to Dali or Kunming. However, the village does not provide better accommodation and food services for merchants. Non-native garlic merchants usually stay in the “Xizhou Ancient Town” for dining and accommodation, which is about two or three kilometers away from Shangyangxi Village. Since the town is a tourist area, the commodity price is relatively high, which does not meet the need of these merchants. As a result, some businessmen have to spend more money and waste more time on transportation. The lack of service facilities has brought about an indispensable influence on the marketing of the primary industry in this village.

3.2. Existing characteristics of agriculture and development dilemma
For a long time, Bai people have traditional customs of building new dwellings [4]. Therefore, apart from some of the economically disadvantaged villagers who still live in traditional houses, most of the villagers have built modern brick-concrete houses. However, many villagers who live in the new houses did not demolish the old traditional houses, but use them as kitchens, guest rooms or storage rooms. Some were just been kept empty and cleaned occasionally. These traditional houses are reasonable in structure and well-designed in materials. Most of them are only damaged in details, such as the eaves, floors, stairs, etc. However, there are also some problems in these houses which do not conform to the contemporary life, for instance, it is of poor sound insulation, abnormal floor sounds, poor lighting, poor conditions of toilets. With the change of times, the property rights of a large part of buildings have become more obscure. This phenomenon is particularly common and obvious after the traditional large courtyard encounters the separation of family members. However, most of the small courtyards in the style of "Three Wing Houses and One Screen Wall" are only inhabited by one family, and their property rights are relatively clear, so this phenomenon will be relatively convenient in the later transformation.

3.3. Attitudes and Appeals of Stakeholders in vernacular dwellings
Recently, since the courtyard is large and there are more spaces in houses for idleness, the villagers are eager to transform their houses for commercial purposes, earning more income to subsidize the
increasing expand, but they do not want to retain too many Bai ethnic elements on the building because they might coast householders more budget. In response to this phenomenon, architects need to engage in a lot of communication with householders and try to persuade them to retain traditional cultural symbols.

The local government has been applying for the "Beautiful Countryside" program to attract more tourists and investment. Therefore, the local government also attaches great importance to the protection of traditional architecture and the development of tourism. However, due to the lack of detailed planning and positioning, the funds available for the protection of buildings are relatively scarce, so in order to increase locals’ awareness of protection and development for their residences, popularizing the relevant conservation concepts to the villagers is significant. Field research shows that garlic merchants need to stay in the village for several days to complete the business, so they need the accommodation, as well as catering and entertainment facilities for consumption.

3.4. Future Industrial and Architectural Development Model
The industrial mode of Shangyangxi village needs to be optimized and upgraded urgently. In agriculture, it is necessary to maintain the dominant position of garlic industry and optimize the planting techniques. In the second industry, in consideration of the current situation, villagers should firstly develop the processing industry which matches the garlic industry, and then gradually develop other processing industries of agricultural products. In terms of the tertiary industry, it is necessary to upgrade agricultural tourism based on the local attractions, and promote some agricultural tourism projects which include some interaction production between locals and visitors.

In the future process of architectural development research, villagers need to reform their understanding of the ethical architectural culture, and communicate with designers about their own difficulties and ideas in detail. For the protection and renovation of such residential houses, the government needs to provide more financial support, and involve relevant departments and professionals in to work out a corresponding planning for protection strategies, and respect the reasonable demands of local villagers.

4. Shangyangxi Courtyards Reform Case

4.1. Overview of the target building and major issues
The target building is located in the western part of Shangyangxi Village. The area is the oldest part of the Shangyangxi, where there are many buildings with a history of over a hundred years. Most of them are conserved in the good condition. But this region lacks corresponding modern commercial facilities (see figure 4).

Figure 4. The condition of the target building. Source: Author Self-painting.

The target selected by this project covers an area of approximately 600 square meters, and the style is typical “three wing houses and a screen wall” style. The structure of the building is relatively regular and the sense of enclosure in whole site is complete. The features of the Bai architecture for the target
are also relatively distinct. There is only a slight damage in the area of the cornice, the wall, the roof and the facing material. There are only two elderly people living in main wing, and two subordinate wings are used as lumber rooms (see figure 5). The households’ offspring have been working outside of village for several years and do not come back frequently. During the previous interviews, we learned that the economic conditions of the household are relatively rich and the education level is high. They also have great interests to our renewal plan. Based on the above advantage, we decided to select this building as a typical case to preserve and reform, and to carry out commercial and well-being renovation.

On the whole, although the layout of the building is complete, the screen wall collapsed due to lack of repair. The building structure is intact, but the wall was partially damaged, and the inner floors and wooden walls are poorly soundproofed. Due to the fact that there are only two people living in this building, the courtyard and parts of the house are unoccupied. From the perspective of infrastructure, the lack of modern bathroom and shower equipment can no longer meet the requirement of residents apparently. Due to the small quantity and diminutive size of the outward window, the lighting and ventilation are not ideal. There is also a certain safety hazard in the wires which are leak outside of the gatehouse.

![Figure 5. The plan of target before renovation, Source: Author Self-painting.](image)

4.2. Renovation strategy
In this courtyard, the household occupies approximate 30 percent of the housing area. While commercializing the remaining homes, a liveable renovation of the space in which the homeowner lives could be supplemented. According to estimates, the modern timber walls and soundproofing materials, as well as a construction team of approximately eight villagers, could satisfy the requirement of the renovation project. In addition, due to the building size, it is simple to implant modern bathrooms and showers. In terms of funding, it was expected to be able to make initial modifications by the user’s existing funds and a small amount of government funding;

The ultimate goal of the renovation project is to transform this building into a place that can not only meet the demand of householders, but also provide garlic businessmen a place for accommodation and rest, and moderately take into account the living requirements of some future tourists. When designers replace the function of the courtyard, it is necessary to leave more space in the original building for the commercial and residential functions. The appearance and style of the target building will be preserved, and only windows should to be upgraded. The main wing was slightly optimized for continued use by households; the other two wings are used for commercial operations. The newly added toilet, bathroom,
kitchen and dining room are designed for public use. Under our guidance, the construction team in the village applied new building materials such as soundproofing materials, partition walls, double-glazed windows and soundproof floors to repair damaged parts of the target building. On the premise of balancing residential and commercial needs, we re-arranged the courtyard and reserved a portion of the courtyard space for drying and storage of garlic to meet the demand of the household, garlic traders and tourists (see figure 6).

4.3. Building function replacement & building structure update

In this renovation, the middle room of first floor in the main wing was designed as a reception, the second floor as the place for ancestral tablets and household’s bedroom and a temporary bedroom. For the two wings, they were converted into guest rooms, and were added the stairs to connect the first and second floors. The original function of the kitchen and dining room in the right leak angle were retained and changed into a modern open kitchen.

| Pre-construction Data                  |
|---------------------------------------|
| Number of Rooms: 17                  |
| Number of Spare Rooms: 7             |
| Spare Rooms Area: 116.7m²            |
| Covering Area: 573.9m²               |
| Gross Floors Area: 415.4m²           |
| Damaged Area: 143.2m²                |
| Number of Toilet Squats: 2           |
| Vegetable Area: 21.2m²               |

| Data after Building Renovation        |
|---------------------------------------|
| Number of Guest Room: 12             |
| Area of Guest Rooms: 14.5m²           |
| Number of Showers: 8                 |
| Household Area: 95.04m²              |
| Serve Area: 235.2m²                  |
| Green Space: 186.6m²                 |
| Service Space Area: 93.2m²           |
| Number of Toilet Squats: 6           |
| Vegetable Area: 40.2m²               |

Figure 6. The plan of target after renovation, Source: Author Self-painting.

Figure 7. The comparison chart compared the date before and after transformation, Source: Author Self-painting.

In the left leakage angle, the original flower house was transformed into a modern bathroom; the original temporary toilet in the courtyard was replaced by an assembled integrated toilet or permanent toilet. In the entrance yard and the central yard, several evergreen broad-leaved trees were planted, and
furniture were added. A glass ceiling was installed upon the courtyard. This can not only raise the temperature of the courtyard in cold winter, but also shelter from the wind and rain in summer. It could supply the household a relatively closed space for leisure and entertainment, as well as garlic merchants (see figure 6).

In the front yard, we reserved a space for drying garlic to facilitate the household and the garlic merchants during the garlic harvest season, and certainly it can be left as an ecological field. When the renovation project is completed, the building which has twelve rooms where they are approximately fifteen square meters separately would accommodate up to twenty people to live in.

In order to maintain the integrity of historical features, a more traditional and conservative maintenance method was conducted after detailed mapping and detailed consultation with local construction workers. According to current situation of the target building, few modifications were made to the load-bearing structure of the building but only some damaged components were replaced. Workers firstly cleaned the broken walls, sorted out the broken bricks, and marked their position. Broken bricks were then replaced from top to bottom using bricks that are shipped from brick factories near Shangyangxi Village. (see picture 8) For crotch that was bent by the building load, workers unloaded its load and replaced them with a new type of wooden beam of the same size; Then original purlins and the old tiles were restored, and the partially damaged old tiles were replaced with new tiles. (see picture 9) For wooden beams and wooden columns that were somewhat damaged due to exposure, local construction workers were requested to spray anticorrosive materials to prevent insects and then restored structures into traditional Bai style.

Figure 8. The repair method of cornices, Source: Author Self-painting.

Figure 9. The method of wall repair, Source: Author Self-painting.

4.4. Building component repair and Detail repair
Workers were instructed to carry out the restoration of the original style of target for two relatively damaged details. One is the screen wall. In courtyard, there used to be a complete yard with a magnificent screen wall. Owing economic issues, the screen wall collapsed more than 30 years, replaced by a wall of cobbles piled randomly about one-metre high, dividing the atrium from the abandoned front yard. According to the traditional “three-fold water” screen wall style of Bai architecture, it was re-designed in the original position. The second repair is the gatehouse. The cornice of the gatehouse was damaged, and some of the pigments were also peeled off. Electrical wiring, ammeter and other facilities also affect the traditional architectural style, so local timber and bricks were applied to replace the damaged components. Then, according to the traditional style, local craftsmen could restore and paint the gatehouse. (see picture 10)
In the detailed transformation of architectural heritage, some new materials and construction methods were introduced. In this regard, the following two principles should be followed. First of all, the use of new materials cannot destroy the overall architectural style of traditional Bai dwellings; secondly, new materials should be able to meet the requirements of use, but also to form a good combination with the original materials. They should be able to complement with each other.

The adobe brick was utilized on the outside of the wall and applied to the openable glass windows, which not only maintains the uniform appearance of the bathroom facade, but also has the functions of ventilation, lighting and cold protection (see figure 12). The original decaying wood boards with poor sound insulation was replaced by using wooden frame partitions made up of crosspieces and diagonal braces; the filled foam board was used as the partition wall and a veneer on the outside. This partition wall is light in weight, and the sound insulation effect is of high quality. It is easy to assemble (see figure 13). The size of the windows was enlarged and traditional wooden doors and windows were installed on the outside for decoration, so as to maintain the overall traditional style of the building facade. New interior windows were installed on the inside of the wooden window, which greatly improved the warmth and sound insulation of the building. In order to prevent the traditional building slab from being damaged by insects and water, which leads to the defects of low service life and poor sound insulation, two materials were applied—straw and new composite wood. The use of straw as a “sandwich” can improve the airtightness of the wall and prevent the moisture from interpenetrating. (see figure 14)
Figure 12. The renovation of bathrooms, Source: Author Self-painting.

Figure 13. The construction of wooden partition wall, Source: Author Self-painting.

Figure 14. The construction of floor, Source: Author Self-painting.
5. Conclusion
Dali is abundant in tourism resources, which attract thousands of tourists every year. A large number of Bai dwellings have been protected and renovated for commercial and residential purposes. However, not all villages in Dali are suitable for developing tourism. At present, many natural villages which are similar to Shangyangxi Village are ordinary villages dominated by handicraft industry or agriculture due to their unique geographical conditions or the historical reason. They have many material heritages represented by traditional Bai buildings, and own many intangible cultural heritages represented by regional and minority life characteristics as well. For protection and renewal of vernacular dwelling, designers and planners should not only focus on the development of tourism with short-sighted interests. Instead, in order to protect and renewal these villages accordingly, it is necessary to research deeper about superior industries and unique cultural heritage of them.

In this project, according to local conditions, this traditional building have been modified and optimized. Under the premise of actively communicating with households, they understand the importance of protecting the Bai architectural heritage. Based on the concept of preservation for this building, we used advanced modern building materials to repair and supplement some of the traditional Bai architectural symbols which were damaged. According to the requirement of households, many functions and infrastructures which satisfy the demands of modern life and commerce were added to the courtyard. The design scheme not only protects these precious architectural and cultural heritages, but also gives the architecture style and layout a certain continuation. This building has thus been given a new life and has been enhanced in its efficiency. In conclusion, it is obvious that the core of the architectural heritage protection is the living conditions. This does not mean that an old traditional building is maintained intact, but in the process of restoration, according to its inherent characteristics, these traditional buildings are given fresh blood and new life.

References
[1] Jixing Li. (2014). History of Politics and Political System in Nanzhao Dali. (Doctoral dissertation, Yunnan University).
[2] Yunnan Digital Village. (2012) Shangyangxi, Wanqiao Town, Dali City, Yunnan Province. http://www.ynszxc.gov.cn/S1/S1228/S1229/S1234/S140512/.
[3] College of Architecture and Urban Planning of Kunming University, College of Architecture of Xi’an University of Architecture and Technology, College of Architecture and Urban Planning of Huazhong University of Science and Technology etc. (2016). Spatial means of rural activation—2016Joint design of four schools in urban and rural planning, architecture and landscape architecture. China Building Industry Press. Kunming.
[4] Qin Zhao. (1999). Xizhou Bai Nationality Residential Complex. Yunnan Ethic Publishing House. Kunming
[5] Yurong Liu. (2006). Study on Bai Nationality Residence in Xizhou Village of Dali. (Doctoral dissertation, Chongqing University).
[6] Xiaomei Zhao, & Yue Jia. (2012). Analysis on the Form and Development of the dwelling of Dong Nationality. Community Design (2), 45-53.
[7] Ming Bai. (1980). discussion Bai faith of "Benzhu". Journal of Southwest University for Nationalities (Humanities and Social Sciences Edition) (3), 61-63.
[8] Peng Chen, & Dong Wang. (2012). Analysis and Application of the Traditional Dwellings of the Bai People in Dali. Huazhong Architecture (10), 169-173.