Study on the Evolution of Guangxi Traditional Pile-Dwelling Architecture —— Take Baise, Guangxi as an example

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Abstract. With the development of history and the transformation and renewal of production methods, human construction activities will reflect the content of production activities at that time to a certain extent. Guangxi is located on the southeastern edge of the Yunnan-Guizhou Plateau, the second step in the topography of the country. Guangxi is located in the western part of the hills of Guangdong, Guangxi. The mountain area is vast, and it is a zone of communication between regions, ethnic groups, and countries. It has rich ethnic and regional cultural characteristics, and various architectural phenomena are splendid. Pile-Dwelling architecture is a traditional dwelling form of the Baiyue people, belonging to a "native" type of regional architecture. It has the innate advantages of using topography and striving for space, and is widely used in the mountainous areas of Guangxi. This paper will take Guangxi traditional dry fence architecture as the research object, and will conduct research on Guangxi's traditional vernacular architectural culture. Through combing and researching the development of dry fence architecture in China, it will summarize the evolution law of Guangxi traditional Pile-Dwelling architecture, in order to protect Guangxi Zhuang's architectural cultural heritage and providing a basis for regional architectural creation in Guangxi. It will be of great significance for achieving ecological harmony and promoting the construction of new towns.

Keywords. Ganlan architecture in Guangxi; Zhuang folk houses; Evolution law

1. Introduction

Because of its early origin and close connection with human settlements, dry-column architecture can restore the living conditions of residents at that time to a great extent, which has great research value and has important research significance in architecture, history, humanities and social sciences and other interdisciplinary subjects. However, according to local statistics, there are only a handful of existing dwellings for investigation. With the acceleration of the modernization process, these traditional residential buildings will be gradually changed or replaced by new buildings with the changes of the times, except for individual residences which are protected by local governments. Therefore, it is urgent in time and necessary in objective conditions to study the dry-column architecture in Guangxi. Through modern research theories and methods, we can form more perfect literature about the dry-column architecture in Guangxi, and make some contribution to the research of the traditional residential architecture in Guangxi.

2. Overview of Chinese Pile-Dwelling architecture

Because of the long historical origin of Pile-Dwelling architecture, relevant scholars have rich research results. First of all, the domestic literature on creating "Ganlan Architecture" comes from Dai Shixuan's "Ganlan: Research on Primitive Residence in Southwest China". It established the ancient word meaning of "Ganlan architecture" and preliminarily classified it according to its characteristics.
It also analyzed the distribution of ancient Pile-Dwelling architecture and preliminarily obtained the propagation path of Ganlan. In this document, it is particularly emphasized that the Pile-Dwelling buildings in Southwest China, including Guangxi, have the original nesting characteristics[1]. During the ten years from 1980s to 1990s, the investigation and research on residential buildings in Southwest China has been widely carried out, and related monographs have been compiled to discuss the architectural forms of residential buildings in different regions, such as Gao Zhenming's Yunnan Residential Buildings, Fujian Residential Buildings, Fujian Residential Buildings, Guangdong Residential Buildings, Guangdong Residential Buildings and so on. However, at this stage, because it is still in the initial stage of research, the main research still stays in the classification description of architectural form, and there is little research on the relationship between its historical evolution and production development. In his "Ganlan Miao Residence Architecture", Li Xiankui took Miao residence in Southeastern Guizhou as the object, and carried out the research on olive architecture in a specific area for the first time. After 1990s, combined with interdisciplinary comprehensive research, studies including technology, economy, humanities, folk customs, etc. have been carried out one after another, and fruitful results have been obtained. For example, "The Pile-Dwelling Architecture of Zhuang Nationality" has made extensive research on the Pile-Dwelling architecture of Zhuang nationality gathering place. In recent years, "Chinese Folk House Architecture Series" (China Building Industry Press, 18 volumes in total) and "Southwest Folk House" (Wu Zhengguang, Tsinghua University Publishing House) have been studied by scholars and researchers of cultural relics, and the combination of theory and practice has perfected the research on local folk houses in China, especially in Southwest China. For example, Jiang Gaochen and Yang Dayu published "Yunnan Ethnic Housing Culture" and other works after visiting and investigating Yunnan ethnic dwellings, which also studied the representative dry-column architecture in Yunnan.

As Pile-Dwelling is one of the distinctive architectural forms in Southwest China, there are special chapters in many works to explain and introduce it. For example, Dai Zhizhong established the relationship between Pile-Dwelling architecture and agricultural production in Architectural Culture of Southwest China, and found the differences of cultural characteristics of Pile-Dwelling architecture under different modes of production, and divided Pile-Dwelling into three modes: "nest residence", "building residence" and "village residence". At present, the existing Pile-Dwelling architectural complex in Guangxi exists in the form of "village residence" defined in the book.

With the growing strength of traditional residential architecture research, since the 21st century, a large number of scholars of architectural history theory have carried out the research of dry column architecture, and the results are quite fruitful, mainly concentrated in journals and doctoral dissertations. In a large number of studies, the main concerns focus on two aspects: the first is the study of architectural characteristics, including settlement form, architectural regulation, construction method and architectural culture, including Cai Ling's traditional villages and buildings in Dong inhabited areas, Zhao Ye's research on Guangxi Zhuang Traditional Settlements and dwellings "Research on the differences of traditional Pile-Dwelling dwellings of Zhuang Nationality in Guangxi" and "Research on the differences of Pile-Dwelling dwellings of Zhuang Nationality in Guangxi" all focus on Pile-Dwelling dwellings in Guangxi, and analyze the differences of Pile-Dwelling dwellings in different regions of Guangxi from sociological and physical geographical factors. Zhao Ye, Xiong Wei and Xie Xiaoying's "modern evolution of Zhuang Traditional Dwellings -- Taking Longsheng Longji village as an example" Taking Longsheng Longji village in Guangxi as an example, this paper analyzes the relationship between the layout of Pile-Dwelling style dwellings, the evolution of component forms and the changes of residents' lives. In order to make the traditional buildings have new vitality, Wei Shiling discussed the organic combination of modern new technology, new technology and new materials to design and build modern new residential buildings from the perspective of architectural design in her book the reference of Guangxi traditional Pile-Dwelling residential buildings to modern architecture. Xiao Guanlan's doctoral dissertation research on Pile-Dwelling architecture system in Southwest Chinasouthwest regional culture, combined with rich practical research, and complements the contribution and evolution characteristics of Pile-Dwelling architecture to the overall human cultural process in the aspect of ethnic relations and historical culture. Mao Guohui's research on climate adaptation and function integration of Dong Traditional Pile-
Dwellings studies the relationship between people, architecture and climate from the technical level, and discusses the ecological design strategy to adapt to the new functional requirements without changing the functional characteristics of traditional Pile-Dwelling dwellings. In Chen chukang's master's thesis "Research on the regeneration of Guangxi Zhuang Traditional Dwellings", using the method of combining quantitative analysis and qualitative analysis, on the basis of field survey and mapping, the design optimization of traditional dwellings was carried out through calculation and simulation. From a more micro level, Xiong Wei, Zhao Ye and Xie Xiaoying's comparative study on traditional Pile-Dwelling dwellings of Zhuang and Dong people compares the settlement layout, plane layout and architectural structure of Pile-Dwelling dwellings of Zhuang and Dong people based on Pile-Dwelling dwellings. On the other hand, it starts from the protection of ancient buildings, such as Zhao Ye, Xiong Wei and Xie Xiaoying's "protection and development of traditional settlements and dwellings of Zhuang Nationality - Taking Longji ancient Zhuang village as an example", and takes Longji ancient Zhuang village as an example to reflect on the protection and development of traditional dwellings. Meng Fanpu's "Longji ancient Zhuang village Pile-Dwelling building protection and tourism development" from the local government, tourism companies, ancient Zhuang village villagers and foreign tourists four different dimensions, adhere to the development principle of "use in protection, protect in use", put forward relevant suggestions to promote the development of ancient Zhuang village Pile-Dwelling building heritage tourism.

The research system on the formation of dry-column architecture in the world is a little later than that in China. At present, the content of international research on this architectural form is not as rich as that of domestic literature, and the main research object is residential architecture which exists in the internationally recognized river birthplace and human culture derivative. E.g. Katarina Ćufar, Willy Tegel's "Eneolithic pile dwellings south of the Alps precisely dated with tree-ring chronologies from the north" mainly studies the pile dwellings architecture in Slovenia, and eneolithic was listed in the world heritage list by UNESCO (United UNESCO) in 2011[2]. P. Angelini; Wood identification of pile dwellings from the bronze age San Savino site (Lake Trasimeno, Central Italy) by M. C. De Angelis et al. focuses on the archaeological research of pile dwellings on the Trasimeno riverbed in central Italy by using the wood age inference method[3]. The main characteristics of foreign scholars' research on dry bar architecture are as follows: firstly, the researchers are mostly ethology or history; secondly, apart from the self-contained research on dry bar architecture in Japan, the dry bar architecture in Asia in European and American countries is mainly concentrated in Southeast Asia, and little attention is paid to Chinese dry bar architecture.

3. Characteristics of Guangxi dwellings
The five characteristics of residential buildings in China include Beijing's "Siheyuan" in North China, Shaanxi's "Cave Dwellings" in Northwest China, Hakka's "Dragon House" in Fujian and Guangdong, and Yunnan's "One Seal" in Western Yunnan. Among them, the "dry-column architecture" in Southwest China, which has the oldest historical origin and is still used up to now, still exists in the central and western Guangxi, southeastern Yunnan, southwestern Guizhou and northern Vietnam[4,5,6,7].

In the new period, the main architectural culture in South China is Hemudu architectural culture[8,9,10], among which the notable architectural feature is dry-column architecture. Because the overhead form of dry-column architecture is suitable for the southern areas with more rain, it has been widely developed in the Baiyue ethnic areas in the south, and the dry-column wooden frame of Hemudu has become the origin of Chinese architectural civilization.

After thousands of years of evolution, its architectural prototype has been hard to trace, but Guangxi, as a gathering place of Zhuang nationality, has become an area where the existing dry-column architecture is concentrated, with rich natural resources and historical and cultural resources to explore the evolution form of "dry-column architecture" in western Guangxi. In addition, because some ethnic minority areas still use dry-column buildings as residential houses, we can study the evolution mechanism from dry-column buildings to modern lifestyles in combination with the living and cultural habits of modern ethnic minority residents. It plays an important role in the study of architectural regulation, cultural influence and historical inheritance of dry-column
architecture[11,12,13]. Because of the scattered distribution of dry-column-style houses in Guangxi, and most of them are mainly residents' lives, there is no sign of clan and cultural belief like ancestral halls and ancient stage[14,15,16,17]. Therefore, in the investigation of Guangxi Ganlan-style dwellings, we mainly focus on some large-scale gathering tribes, and at the same time, we separately analyze those with special shapes. At present, the existing dry-column buildings are mainly concentrated in Hechi in northwest Guangxi, Longsheng and Luizhou in northeast Guangxi, Baise in west Guangxi, Qinzhou and Fangchenggang in southeast Guangxi, Nanning and Guiliang, among which Longsheng, Baise and Nanning are the most concentrated. The name of dry-column style Zhuang folk houses originated from Zhuang language, which is also called "Malan" locally. According to different forms, it is divided into full-dry columns and semi-dry columns (as shown in Figure 1). Full-dry columns are scattered in remote areas of Guangxi, while semi-dry columns are built according to mountains and hills, which are more common in mountainous and hilly areas[18,19,20,21].

![Full Pile-Dwelling type](image1) ![Half Pile-Dwelling type](image2)

**Figure 1.** Classification of pile dwelling buildings in Guangxi.

In the preliminary investigation, the author mainly collected the typical Pile-Dwelling architecture in Guangxi. Due to the scattered distribution, the residential buildings with large scale and effective protection to keep the complete shape are taken as the research objects, and the list is as follows:

**Table 1.** Representative Pile-Dwelling Buildings in Guangxi.

| Name               | Pile-Dwelling shape | Place address               | Summary                                                                 |
|--------------------|---------------------|-----------------------------|-------------------------------------------------------------------------|
| Xilin Hezhai       | Full Pile-Dwelling  | Xilin County, Bose City, Guangxi | The first batch of "List of Chinese Traditional Villages" and "The First Village of Zhuang Pile-Dwelling Culture" |
| Debao Hezai        | Full Pile-Dwelling  | Debao County, Bose City, Guangxi | Included in the list of villages with Chinese ethnic characteristics |
| Napo Huangzai      | Full Pile-Dwelling  | Napo County, Bose City, Guangxi | One of the workstations of Guangxi National Museum, dynamically protects the unique Pile-Dwelling architectural complex in black |
| Huanjiang Mozhai   | Half Pile-Dwelling  | Huanjiang County, Hechi City, Guangxi | Datang Tun, the birthplace of Maonan nationality in Guangxi, is located on the national defense highway from Huanjiang to Bagong. The village still retains the characteristics of Maonan nationality in residential style, village style, living customs and industrial structure. |
| Longsheng Liaozhai | Half Pile-Dwelling  | Longsheng County, Guilin City, Guangxi | Built on the mountain, facing southeast, the first floor is supported by columns without enclosure structure. Protection units of traditional dwellings in northern Guangxi. |

### 4. Evolution law of Pile-Dwelling dwellings in Guangxi

Guangxi, as a minority area, has a long history of the origin and development of Pile-Dwelling...
architecture, and because of the close relationship between residential buildings and people's lives, there are a large number of Pile-Dwelling architecture at present. Through investigation, it is found that although Guangxi is a gathering place of Zhuang people, even the same ethnic group will have different architectural forms, construction methods, construction characteristics, construction techniques and material selection in residential buildings in different regional locations. It is closely related to living habits, natural environment, cultural customs, and main modes of production, which will reflect the life style and cultural attitude of the people in this region to a certain extent.

Therefore, the development history and evolution process of Pile-Dwelling style residential buildings in Guangxi are gradually changing with the evolution of geographical and natural conditions in Guangxi and the changes of people's living standards and folk customs. It is characterized by the combination of nationality and economy, and has certain regional characteristics in architectural functions.

(1) comprehensive functions. Guangxi is located in the southwest, with low latitude, hot weather and high surface temperature. Therefore, as the main living place, residential buildings require a cooling system, including sun protection, heat insulation and ventilation. Dehumidification and drainage functions are required in the moisture-proof system. It is required to have rainwater circulation function, biomass energy circulation function and heat energy circulation function in the energy circulation system. See table 2 for the main ways to realize the above functions in Pile-Dwelling buildings:

| Functional system       | Implement functions                                                                                                                                                                                                 |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cooling system          | Anti-sun function                                                                                                                                                                                                      |
|                         | Realized through a larger roof                                                                                                                                                                                        |
|                         | Achieved through eyes and eaves                                                                                                                                                                                        |
| Heat insulation function| Use wood structure to realize heat dissipation                                                                                                                                                                        |
|                         | Using overhead layers to realize air circulation and heat dissipation                                                                                                                                                 |
|                         | Use upper and lower insulation construction techniques to isolate hot air                                                                                                                                               |
| Ventilation function    | Through the design of the fireplace room, the rise and convection of the bottom hot air are realized                                                                                                                                 |
|                         | Ventilation is realized by raising the height of the floor                                                                                                                                                             |
|                         | Achieve the overall ventilation effect through partition and compartment                                                                                                                                             |
| Moisture-proof system   | Dehumidification function                                                                                                                                                                                            |
|                         | Isolation of ground moisture through overhead ground floor                                                                                                                                                           |
|                         | Drainage of moisture through high-rise buildings and ventilation                                                                                                                                                     |
|                         | Dehumidification by ventilation system                                                                                                                                                                                 |
| Drainage function       | The use of permeable materials is conducive to the discharge of moisture in the house                                                                                                                                 |
|                         | Through the roof and eaves design, the rainwater will be diverted to a position far away from the house                                                                                                               |
|                         | Use ground drains to drain rainwater                                                                                                                                                                                   |
| Energy cycle system     | Rainwater circulation function                                                                                                                                                                                          |
|                         | Drain rainwater to the edge of the field to irrigate farmland                                                                                                                                                         |
| Biomass energy cycle function | Raising livestock on the overhead ground floor can be used to consume kitchen waste                                                                                      |
|                         | Collect human and animal feces to irrigate farmland and build biogas digesters                                                                                                                                       |
| Heat energy circulation function | The smoke generated during cooking is used to dry and smoke food for long-term preservation                                                                         |

(2) The combination of strong and strong. With the geographical migration and integration of many ethnic groups in history, the cultures of Zhuang and Han people have many intersections. Therefore, it is not difficult to find the integration characteristics of Zhuang and Han people in Pile-Dwelling dwellings in Guangxi by tracing back to the Pile-Dwelling architecture in Guangxi and analyzing its
development law. The etiquette system in Han culture has brought new changes to the pattern of ancient Pile-Dwelling dwellings, especially in large clan dwellings. And in the Bay size, plane, decoration and so on all reflect certain standards and paradigms, so that future generations can sort out the social status of the owners of the houses at that time, folk customs and other related human factors from the existing buildings.

(3) The decoration is simple and bright. The pile dwelling style residential building has the characteristics of clear segmentation and light shape from the facade structure, so the overall style is relatively simple and lively. But for the local details of the building, it still has certain characteristics in the architectural decoration, and it can also sort out the information such as the clan level from the decorative shape and symbol. For example, dogs and fish are commonly used in ordinary families to reflect the vision of a safe and prosperous home, while wealthy families will depict exquisite dragons, beasts and totems, which have a certain degree of majesty. However, no matter what kind of decoration, it will be consistent with the transparent architectural style of Pile-Dwelling architecture, which will bring out the beauty of decoration and the practicality of architecture.

5. Conclusions

Pile-Dwelling architecture has a long history of development and evolution in Baise, Guangxi, from the initial bird's nest model to the practical and safe model, and it is highly correlated with local geographical features, natural conditions and raw materials. Architecture is an important embodiment of humanistic thought and has important research value. Therefore, the pile dwelling style residential buildings in Guangxi have become the product of the specific geographical environment of Guangxi, which is of great significance to the study of the evolution of the relevant historical culture and architectural form.

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