

Study on the Architectural Space Characteristics and Cultural Causes of Diaofang Folk Houses in Maerkang

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Abstract

The traditional Diaofang in the Maerkang region exhibits distinct regional characteristics and serves as a representative example of Diaofang architecture. This study focuses on the traditional Diaofang dwellings in Maerkang, conducting an in-depth analysis of their architectural spatial features, including layout, elevation, and structural systems. The analysis is based on primary data collected through field visits, surveys, and measurements. Furthermore, the research investigates the relationship between these dwellings and the local human history and natural environment, aiming to provide foundational data for a comprehensive understanding of Diaofang architecture in Maerkang.

Keywords

Diaofang Dwellings, Maerkang, Spatial Characteristics, Cultural Influences

1. Introduction

Maerkang City is located in the northwest of the Sichuan Basin, bordering the Hongyuan Prairie to the north and the Wolong Nature Reserve and Siguniang Mountain to the south. In the local dialect, it means “a place with strong flames” [1]. The geographical location of this place is very special. It is located in an area of low latitude and high altitude. Coupled with the unique three-dimensional climate conditions of the high mountain valley, the climate here is characterized by synchronized rainfall and temperature, abundant sunshine, and significant temperature difference between day and night. Surrounded by mountains, Maerkang is a place with rich and diverse resources, especially stone and wood resources.

Maerkang’s traditional Diaofang houses show distinct regional characteristics and are uniquely representative compared to Diaofang houses in other places. In

recent years, with the continuous growth of Maerkang's urban economy, the economic status and quality of life of residents have been significantly improved. Therefore, many people have become keen on renovating their homes, and sometimes even demolish their original homes to obtain stone to build new homes. However, during the survey, we noticed that residents no longer use traditional Diaofang construction methods during the construction process. New materials such as cement and colored steel tiles began to appear frequently, and there were also differences in the design of details such as doors, windows, eaves and railings, which led to the gradual loss of traditional residential elements. Therefore, it is urgent to study the spatial characteristics of traditional Diaofang dwellings in Maerkang area.

At present, the research on traditional Diaofang dwellings in Maerkang area mainly focuses on the macro description of historical and cultural background and overall village planning, and there is a lack of in-depth research on its architectural space characteristics [2] [3]. This paper is committed to a systematic and in-depth analysis and research on the architectural space characteristics of Maerkang Diaofang dwellings in three dimensions: plane layout, facade form and spatial load-bearing structure, and further explores the intrinsic relationship between these characteristics and the cultural and historical background and natural environment. Its purpose is to provide a solid theoretical basis and detailed data support for the design and construction of new Diaofang dwellings in Maerkang, so as to effectively promote the protection and inheritance of local Diaofang dwelling culture.

2. Overview of Maerkang Traditional Folk Houses

As people's living standards continue to improve, traditional dwellings in Maerkang are facing large-scale renovation and demolition and reconstruction, resulting in a gradual decrease in the number of traditional dwellings. This study conducted detailed interviews and surveys of 15 traditional dwellings in Maerkang and found that these buildings are in a fairly good state of preservation. The main reasons for the selection are as follows: first, the samples are all national-level traditional villages, which are almost models of local village styles; second, the architectural styles in the same village are similar due to the style requirements; finally, these samples cover multiple eras and can reflect the changes in functional requirements in different periods. For example, the ground floor space gradually evolved from a livestock room to a storage room. Although a few of the dwellings are damaged or need repair, this does not hinder the in-depth study of the spatial characteristics of the dwellings. The main distribution of the research objects covers a relatively wide area, making them representative. For basic information about the dwellings, please see **Table 1**.

2.1. Overall Layout and Master Plan

The site selection method of Maerkang rural settlements emphasizes adapting to local conditions, building on the mountain, and cleverly utilizing the existing

landforms and topography. It follows the principle of harmonious coexistence between the village and the natural environment. The settlement form can be divided into three different distribution forms: strip, cluster and scattered. The Seermi Village, where the DF02 (**Figure 1**) residence is located, is taken as the research object. The village buildings are mainly distributed on the half-slope of the plateau, not far from the river (**Figure 2**). The scale is relatively small, and the overall layout presents a sparse and orderly strip. In the internal structure of this settlement, the houses are connected to each other through staggered paths, making transportation extremely convenient. The houses are surrounded by open farmland, providing a pleasant environment.

The overall layout of the building occupies a large space, usually including the main building, courtyard and other ancillary structures (such as storage space and places for sundries). The outer wall of the courtyard is perfectly integrated with the outer wall of the residential building, without a clear boundary. The main part of the building is usually three to four stories high, while the ancillary rooms are built of stone or wood, usually one story high. These rooms are close to the main body or courtyard wall, and their area and scale are relatively small, being mainly used to store sundries and items.



Figure 1. DF02 Architectural drawing of the blockhouse in Seermi Village.



Figure 2. DF02 location in Seermi Village.

Table 1. Basic information of Maerkang.

Number	Plies	Village	Elevation
DF01	3	Seermi village	About 2960 m
DF02	3	Seermi village	About 2960 m
DF03	3	Zhibo village	About 2580 m
DF04	3	Zhibo village	About 2580 m
DF05	3	Chunkou village	About 3530 m
DF06	4	Chunkou village	About 3530 m
DF07	3	Congen village	About 2760 m
DF08	5	Congen village	About 2760 m
DF09	3	Galan village	About 2700 m
DF10	3	Galan village	About 2700 m
DF11	3	Daiji village	About 3500 m
DF12	3	Daiji village	About 3500 m
DF13	3	Xisuo village	About 2660 m
DF14	3	Xisuo village	About 2660 m
DF15	3	Shijiangju village	About 2600 m

2.2. Plane Function

Traditional Diaofang buildings are usually three to four stories high, and mainly use classic stone and wood structures. The floor plan of these buildings is square, and the walls on all four sides are made of stacked stone slabs, and the middle is filled with yellow mud for reinforcement. The design of the wall is very unique, the interior is straight, and the exterior is slightly inward, forming a natural arc effect. The floor design is very flexible, typically ranging between three and four floors. The first floor is used for livestock, and the second floor includes functional areas such as “guozhuang” (kitchen + living room), living room and bedroom. On the sunny side of the third floor is a dedicated chanting hall, next to which are the living room and bedroom for monks, and there is a mulberry platform in the corner (**Figure 3**). This arrangement makes it possible to distinguish the three-dimensional spatial levels of livestock, residents, and gods, and is also a reflection of local culture. The roof structure may be a double slope in the shape of a human figure, or a half-slope design, and the materials used include slate, red tiles, and colored steel tiles.

During the field research, it was found that the local buildings have thick walls and small window areas, which makes the buildings warm in winter and cool in summer, and the indoor thermal comfort environment is good, but the natural lighting is poor, and artificial light sources are usually needed; according to the interviews with the residents, the size and number of the rooms in the building can meet the daily life of the residents, and only a small number of residents want to add a bathroom.

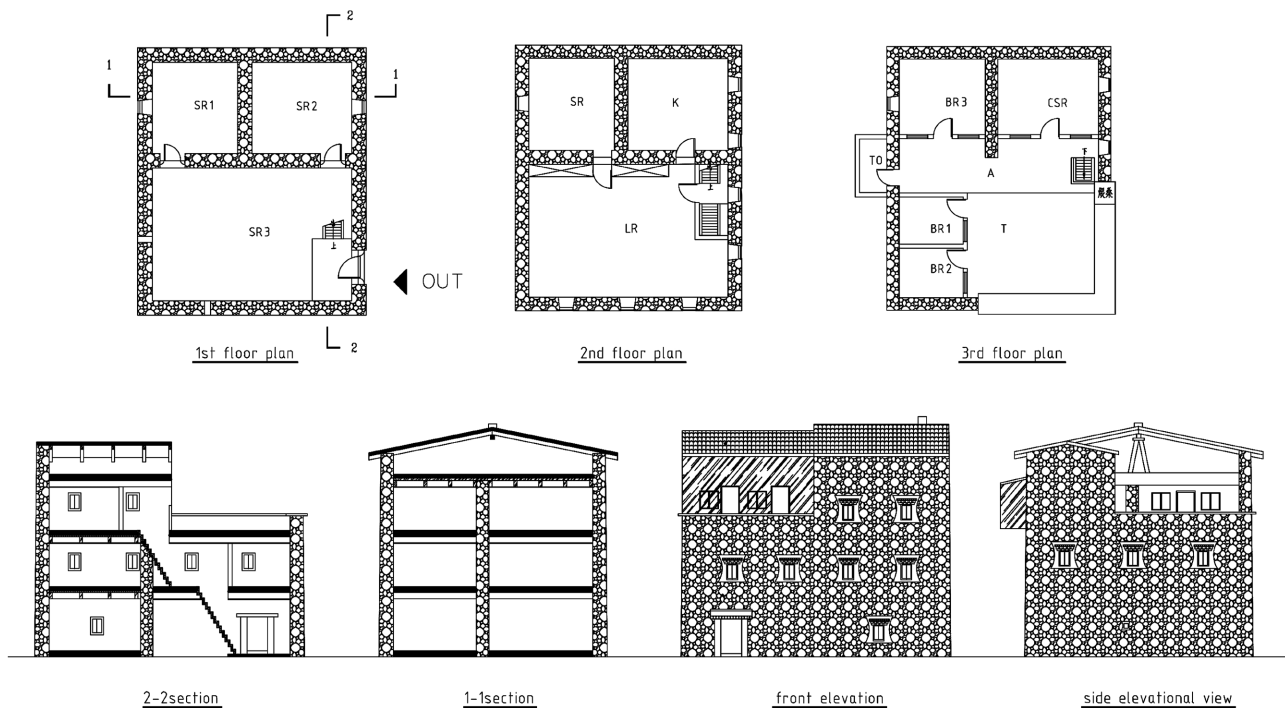


Figure 3. Vertical profile of Maerkang blockhouse.

3. Analysis of the Plane Characteristics of Maerkang Residential Buildings

3.1. Plane Feature Extraction

Based on detailed maps of dwellings and photos obtained from field investigations, we conducted an in-depth basic study of traditional Diaofang dwellings in the Maerkang area. We recorded and counted the plane elements of each floor of the dwellings in detail and found that livestock room, staircase, aisle, storage rooms, kitchens, living rooms, bedrooms, toilets, open rooms, chant sutras room, terraces and eaves corridors are common elements in Diaofang dwellings [4]. Therefore, these 13 plane elements are considered to be the focus of this study. In order to better support the subsequent research tasks, we chose to use English letters to record these two-dimensional elements in detail. **Table 2** shows the corresponding records and explanations of each element in English.

3.2. Analysis of the Relationship between Plane Elements

Using graph theory research methods based on space syntax theory, we conducted a detailed analysis and processing of the plane design of 15 traditional houses in Maerkang City. The plane elements of each floor of the house are simplified into a graphical relationship diagram of points and lines. A complete network model is constructed based on this. In the combination of various planes, “points” represent the components of each layer of the plane, and these elements are clearly divided by corresponding English labels. Through the “line segment”, we can clearly see the connection method of the plane elements between each point, and

the two ends of the line segment are the plane elements of the two connection points. By sorting out the drawings of 15 houses, we obtained **Figure 4**.

Table 2. Notes and definitions of basic elements of plane.

Plane element	English mark	Chinese interpretation
Livestock room	C	Captive cattle, sheep, livestock, etc.
Staircase	S	This refers to a single ladder or a stepping wooden ladder
Aisle	A	corridor, hall,
Kitchen	K	Kitchen, dining room
Storage room	SR	To store or store objects.
Living room	LR	Living room, double bedroom
Open room	OR	Open space on top
Terrace	T	Roof terrace on top floor
Toilet	TO	Dry toilet, no flushing
Bedroom	BR	bedroom
Chant sutras room	CSR	Religious belief space for reciting scriptures and pilgrimage to living Buddha
Coliseum	CO	Cornice corridor of entrance gate on the first floor
Toutdoor	OUT	Outdoor, outdoor, outdoor

Based on the framework of **Figure 1**, a statistical analysis is performed, focusing on the line segments between different connection points to quantitatively describe the connection density of two plane elements. This density index provides an intuitive basis for evaluating the correlation between two elements. It is worth mentioning that when performing statistical analysis, the directionality of the line segments is not taken into account, so “AS” and “SA” are considered to be the same connection event and counted. In addition, the connection density between specific elements and other plane elements is also analyzed as an important indicator to measure the activity of the element in the plane layout. High-frequency connections may imply the characteristics of the element as a transportation hub, while low-frequency connections may indicate that the element is used less frequently and has limited functions. The connection density between different levels of each plane element is carefully recorded and organized in **Table 3** for reference in subsequent analysis.

We conducted in-depth research and analysis on the adjacency relationship and frequency between plane elements based on the plane drawings and concluded:

1) The connection frequencies of “OUT-C”, “OUT-S” and “OUT-SR” are 9, 7 and 8, respectively. The livestock room (C) or storage room (SR) usually occupies the entire plane space of the first floor. With the gradual improvement of the living environment, the space between livestock has been transformed into storage space, but it does not affect its role as a key transition area connecting residents’ lives with the external environment.

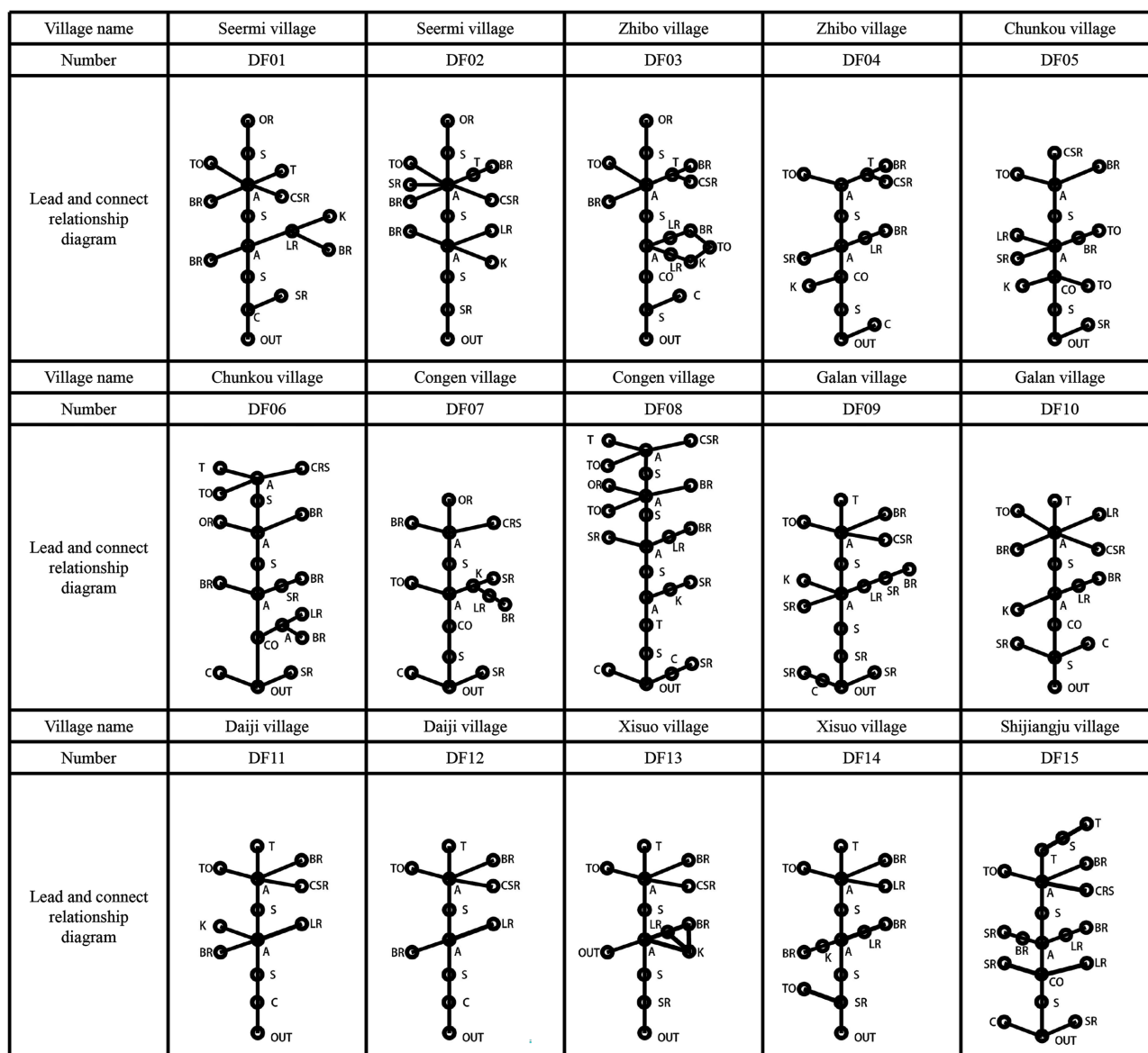


Figure 4. Schematic diagram of connection relationship between residential plane elements.

2) “S-A” is connected 15 times, “CO-S” is connected 6 times, and “OUT-S” is connected 7 times. This batch of data clearly reveals the close relationship between the aisle (A) and the staircase (S). The interaction between the staircase (S) and the veranda (CO) and the outdoors (OUT) is frequent, which means that the integration of the aisle (A), Staircase (S) and the veranda (CO) has become a key part of the traffic layout and plays a vital role in traffic conversion between the internal and external spaces of the residential house.

3) Within the scope of this article’s investigation, there are a total of 13 three-story houses, among which the number of connections of “CSR-A” and “A-T” are both 13. This finding reveals the close interrelationship and functional similarity between the chant sutras room (CSR) and the sun terrace (T), which are the most common elements in the three-story plan of Maerkang Diaofang dwellings.

4) The number of “TO-A” connections reached 15. Research shows that the layout of the toilet (TO) is usually combined with the aisle (A), and in most cases it is set on the gable of the third floor, which is isolated from the main living area on the second floor.

5) The storage room (SR) is connected to all the plan elements on the first and second floors, but it does not show a strong connection with any single element. This shows that in the context of modern use, residential buildings will experience the replacement and derivation of multiple rooms with storage functions.

6) The number of connections between “K-A” and “LR-A” is 7 and 14, respectively, while the number of connections between “CSR-A” reaches 13. From the collected data, we can observe that residents frequently use the kitchen (K), living room (LR) and chant sutras room (CSR), which also reflects their higher expectations for traffic convenience. Therefore, these three areas are closely related to the aisle (A), a crucial traffic conversion element, to meet their various needs that are frequently used in daily life.

After a comprehensive analysis of the six data points, we can have a deeper understanding of the floor plan layout of the traditional Diaofang residences in Maerkang. Such a connection mode can be regarded as the logic of the internal space design of the Diaofang residences. In other words, the floor plan layout of the Diaofang residences uses staircase and aisles as traffic hubs, forming a parallel layout in which all functional rooms are interconnected through aisles.

Table 3. Statistics of adjacency frequency of plane basic elements.

	C	S	A	K	SR	LR	OR	T	TO	BR	CSR	CO	OUT
C	/	5	0	0	3	0	0	0	0	0	0	0	9
S	5	/	15	0	5	0	3	2	0	0	0	6	7
A	0	15	/	7	6	14	3	13	15	14	13	5	1
K	0	0	7	/	1	2	0	0	1	1	0	2	0
SR	3	5	6	1	/	1	0	0	1	3	0	1	8
LR	0	0	14	2	1	/	0	0	0	7	0	1	0
OR	0	3	3	0	0	0	/	0	0	0	0	0	0
T	0	2	13	0	0	0	0	/	0	2	1	0	0
TO	0	0	15	1	1	0	0	0	/	2	0	1	0
BR	0	0	14	1	3	7	0	2	2	/	0	0	0
CSR	0	0	13	0	0	0	0	1	0	0	/	0	0
CO	0	6	5	2	1	1	0	0	1	0	0	/	1
OUT	9	7	1	0	8	0	0	0	0	0	0	1	/

4. Residential Space Construction and Load-Bearing System

4.1. Space Creation

The functions and spatial layout of traditional watchtowers and dwellings are de-

signed to meet the basic needs of production, life, and religious activities. These functions not only meet the needs of production and life, but also include drying food on the roof and raising livestock on the ground floor to alleviate the shortage of production land in mountainous areas. In addition, the religious function layout of the house also reflects the needs of daily Buddhist religious activities. Its vertical functional division is closely related to religious concepts, which is manifested in the division of “livestock → human → god” from bottom to top [5].

The building plan usually adopts a cross-shaped interior wall design with two bays and two depths. In the vertical direction, each floor is connected to the others by a ladder or a single wooden ladder. In the horizontal direction, the spatial connection is mainly achieved by staircase and corridors. At the same time, there is a connection between the various functional rooms, with the traffic space not being independent [6]. The prominent drying platform space reflects the production and living needs of the local mountain agricultural production model.

Due to the great influence of religious culture when building houses, people pay more and more attention to the traditional things. Craftsmen and foremen are also influenced by this. Most of them inherit the old system without much change in structure and technology. Once the main structure and construction methods of buildings in a village are finalized, they remain basically unchanged for hundreds of years. In addition, the terrain in western Sichuan is relatively complex, and there is less communication between villages. In a sense, it protects the regional architectural characteristics.

4.2. Load-Bearing System

There are two main considerations for the use of wood and stone structures and small windows in the Maerkang Diaofang buildings: first, natural resources and climate. The local climate is extremely cold and the ultraviolet rays are strong, so wood and stone are used in construction, and the walls are thickened to achieve the effect of improving the indoor thermal comfort environment; second, the early local residents needed to guard against robbers, and stone buildings could provide a greater sense of security.

The architectural structure of a Diaofang can be divided into two main categories: wall-bearing and beam-column-bearing. The main structure of a Diaofang is made of wood and stone, with stone walls being the main load-bearing method. However, on higher floors, wooden columns and solid walls share the weight. Therefore, the architectural structure of a Diaofang can be divided into two main categories: top-mixed structure and full-mixed structure. The top-mixed structure refers to the use of pure walls to bear the load on the ground floor, with only walls and columns bearing the load on the top floor, where wooden columns primarily replace stone walls. The full-mixed structure refers to the use of some wooden columns to replace the load-bearing walls in the lower structure of the building based on the original wall-bearing structure, thus showing a wall-column-mixed load-bearing method in the architectural structure [7] (as shown in **Figure 5**).

The thickness of the bottom wall is usually between 90 and 100 cm, while the thickness of the top walls is reduced. When it reaches the top floor “Weisangtai”, the thickness is reduced to 50 and 60 cm. The thickness of the outer wall is much greater than the thickness of the inner wall. When constructing the wall, wooden beams are cleverly integrated into each floor to support the weight of the floor. The arrangement and layout of the wooden beams are flexibly adjusted according to the specific needs of the building, with multiple wooden beams sometimes arranged side by side. For the lower areas of the building, one end of the wooden beam is usually closely connected to the partition wall, and the other end goes deep into the internal wall of the building to form a stable support. When the building rises to higher floors, wooden columns will be added in some places to share the load of the floor with the wall. When constructing the building plane, if the width of the building is large and the depth is small, the horizontal wall load-bearing method is usually chosen; otherwise, the longitudinal wall load-bearing method is preferred; on the upper floors of the building, the mixed load-bearing method of wall and column dominates.

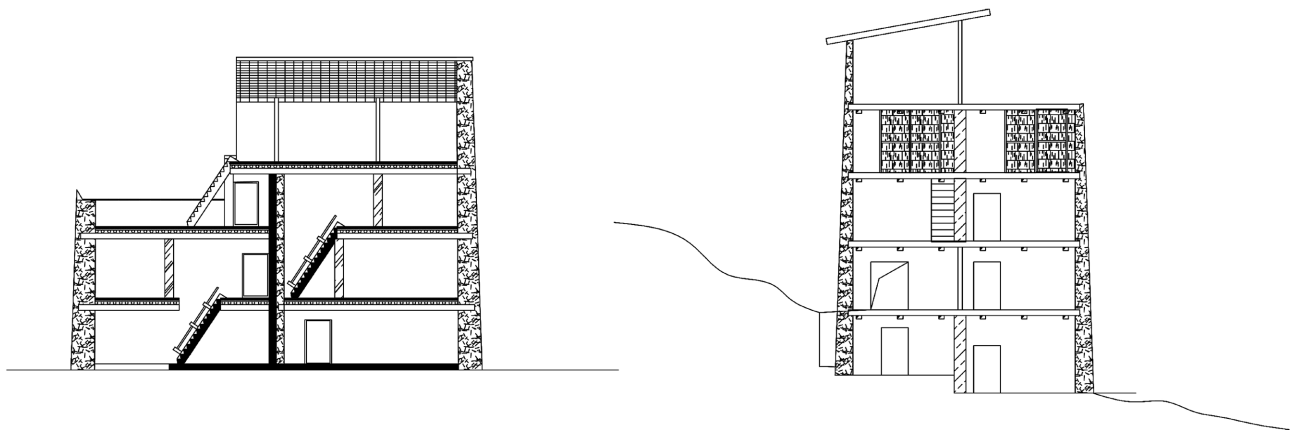


Figure 5. Top-mixed structure (left), full-mixed structure (right).

There are many ways to connect wooden columns to beams. In addition to placing wooden beams directly on wooden columns, there are also methods of adding pads to wooden columns, placing wooden beams on the pads, and finally placing additional wooden beams on the existing wooden beams. The relationship between the wooden beams can be vertical or parallel. There are also methods that omit the pads and directly connect the wooden columns to wooden beams to the wooden beams. There is also a method of directly connecting the wooden columns to wooden beams under the main wooden beams [8].

The structural layers of the floor can be summarized as follows: the first layer is the wooden beams, which are relatively loose in layout and function primarily to provide support; the second layer is the wood waste, whose main function is to serve as a cushion for the ground and support the weight of the upper structure; the third layer is composed of tree branches, whose main function is to support the yellow soil above; the fourth layer is called the yellow mud layer, whose main

function is to disperse the load of the upper layer. Such a structural design is environmentally friendly to a certain extent [9]. First of all, wood is essentially a renewable material; secondly, this building structure does not use cement mortar, and the various layers of the floor are not tightly connected, providing good ventilation, so that the air in the room is always in a state of circulation.

5. Residential Facades and Decorative Features

5.1. Facade Features

The houses in Maerkang Diaofang have tall walls and unique exterior designs. Their exterior walls are all made of stone pieces or stones, which are arranged in a flat manner without a fixed pattern, making them highly flexible. In the gaps between the stone pieces, mud will be injected, and the larger stones will be stacked with small pieces of stone around them, making the walls more stable and strong. After a long period of scouring, the color of the stone has changed, giving the building a color that appears carefully carved by the environment. Religious patterns are painted with white dye on the entrances and gables of many buildings (Figure 6). Although these patterns may gradually become mottled and fall off over time, we can still vaguely see traces of the past.

The window openings on the facade vary in size and are flexible in design. They are generally designed with a tapered shape. The lower layer is particularly prominent and is generally called the “lookout”. It is decorated with exquisite double-leaf wooden partition windows and wooden eave decorations. In terms of structural design, it is common to have a 10cm thick wooden beam on the upper part and two layers of wood carvings on the lower part. In contrast, the design of the main door is simpler and clearer. The door opening is about 1.8 meters high and 80 – 100 cm wide. The lintel is made of wood, slightly wider than the opening, and is equipped with a quarter-round wooden column on the frame. The door panels are painted with religious patterns, and the lintel is hung with animal bones or religious ornaments, making it a unique decoration here.

5.2. Decorative Features

The traditional Diaofang architectural style of Maerkang is deeply influenced by its religious color tradition, leading to a preference for the use of unprocessed raw materials. The exterior walls are often decorated with white, which represents auspiciousness and beauty; red is the main color of the core areas, such as eaves, balcony beams, pillars, railings, doors and windows, symbolizing solemnity and the protection of the law. The overall tone is bright and exaggerated, with a preference for high-purity sky blue, orange, bright red and bright green [10]. Doors, windows, ceilings and furniture are the focus of decoration, including geometric, plant, historical and legendary decorative patterns and wood carvings (Figure 7). A series of square wood carvings are usually carefully carved on the doors and windows. These patterns are brightly colored, and the decoration of the window edges is centered on plant flowers and geometric shapes, fully reflecting people’s deep emotions for life.

The most lavishly decorated areas are the scripture hall and the living room.

Although the color of the exterior of the building is consistent with the religious order, the decoration and details of the interior show a strong sense of freedom and liveliness. The wood carving craftsmanship on the doors and windows is diverse, with bold and bright colors. It pursues a unique beauty and prefers to use original materials. Windows and ceilings are often decorated with auspicious plants and flowers, which not only demonstrates the cultural vitality of the nation but also expresses the passion for life.



Figure 6. White decorative pattern.



Figure 7. Living room furniture decoration.

6. Conclusions

The residential houses in Maerkang Diaofang have a mature architectural system that aligns with the local customs and culture. These residential houses are constructed using local materials and adopt wood and stone structures. The internal space is divided into two levels through different structural systems, and the various spatial elements are connected by stairs and corridors, thus forming various functional rooms inside the residential houses; Due to the local climatic conditions, such as strong sunshine and hot summers and cold winters, the appearance of the residential houses is very enclosed. The design principles of windproofing, dustproofing, heat insulation, and cold proofing are followed during construction. The walls are thick and the windows are few, which are both decorative and practical, showing that the building adapts scientifically to the natural environment. From the first floor to the third floor, livestock, human settlements and natural gods are arranged in sequence, not only meeting the needs of daily production and life, but also serving as an intuitive presentation of the unique natural and national beliefs of the local construction.

It is precisely because of natural, historical, and cultural factors that the Diaofang buildings in other regions are different. For example, the “Bengke”-style Diaofang in Ganzi Prefecture mostly adopts civil structures, with rammed earth walls and wooden partitions on the upper floors, while Maerkang adopts wood and stone structures, with mixed load-bearing on the upper floors. They are all formed under different natural and humanistic restrictions. However, due to geographical and climatic reasons, they all have thick walls and small windows.

In general, the unique Diaofang architecture in Maerkang is the result of a combination of rich historical background, profound cultural traditions, special geographical environment and climatic conditions, and has become a unique branch of the Diaofang architectural system. Through the integration of multiple factors such as the spatial layout of the building, the building structure and its construction methods, these characteristics reflect the adaptability of local architecture. Nowadays, with the continuous improvement of living conditions, many new materials and new technologies have been applied to the renewal and construction of buildings, but when we use them, we should protect the coordination between the original architectural style and the overall village, do not copy foreign architectural structures and styles, and protect and inherit their cultural characteristics.

Although the sample in this article is a model and representative of local architecture, due to the insufficient number, it cannot fully reflect the subtle differences of all buildings. There is a certain degree of error in the analysis process, but it does not affect the overall results. However, in future research plans, we will expand the sample size to enhance the amount of data and the universality of the conclusions.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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