

Research on the Spatial Characteristics of Traditional Residential Buildings in Ningxia Region

LI Yan-jun

Design and Art Department, Shaanxi University of Science
& Technology, Xi'an, Shaanxi, 710021, China

ZHANG Xiao-yu

School of Art and Design, Zhengzhou Vocational College of
Taxation and Finance, Zhengzhou, China

WU Li-yue

Design and Art Department, Shaanxi University of Science & Technology, Xi'an, Shaanxi, 710021, China

This article takes traditional residential buildings in Ningxia region as the starting point, and through field research and data analysis, demonstrates the specific elements of the spatial composition of traditional residential buildings and the common forms of courtyard space. The study summarizes the regional cultural characteristics of traditional residential buildings in the region, laying a foundation for subsequent research and providing some reference basis.

Keywords: Silk Road, Ningxia, traditional residential buildings, architectural spatial characteristics

Introduction

The Hui population in Ningxia accounts for 54.3% of the total population of Ningxia, which is the largest Hui settlement area in China. In the process of long-term mixed living with the Han Chinese, traditional residential architecture as a carrier, the local gradually formed with distinctive regional characteristics of the residential culture and art forms, this section will describe the unique environmental impact, the Ningxia region to form a unique architectural art forms. For the study of the spatial form and architectural space of traditional residential buildings, the spatial layout of the courtyard is particularly important. The architectural space of the residential buildings serves as different functionality, and the overall functionality of the aggregation gives the space vitality, and also meets the daily living.

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The pictures in this article are drawn and photographed by the author.

LI Yan-jun, Doctoral Supervisor, Professor, Design and Art Department, Shaanxi University of Science & Technology, Xi'an, Shaanxi, 710021, China.

ZHANG Xiao-yu, Master's degree, teaching assistant, School of Art and Design, Zhengzhou Vocational College of Taxation and Finance, Zhengzhou, China.

WU Li-yue, Doctoral students, Design and Art Department, Shaanxi University of Science & Technology, Xi'an, Shaanxi, 710021, China.

Site Selection and Layout of the Settlement

The architectural form of the local traditional houses in Ningxia includes the layout of the site, the characteristics of the construction and the indoor structure. First of all, due to the influence of natural environmental factors such as topography, river system, environment and climate, different types of villages have different external features. Secondly, due to the influence of villagers' life style, productivity, social organization and national culture, the spatial function of the interior of the compound produces different spatial structures. In addition, this chapter also systematically studies the art forms from the external architectural decorative art and the interior furnishings.

Each traditional village in Ningxia region has a strong purpose of choosing to build houses, and this concept of choosing to build an address can be summarized into two aspects according to different needs: one of them is the material level of survival, physiological and safety needs (Huang & Li, 2022, pp. 99-100); the other side of the remaining spiritual level of people in pursuit of development, desire for communication and faith needs.

1. Satisfying Material Needs





1.1 Topography



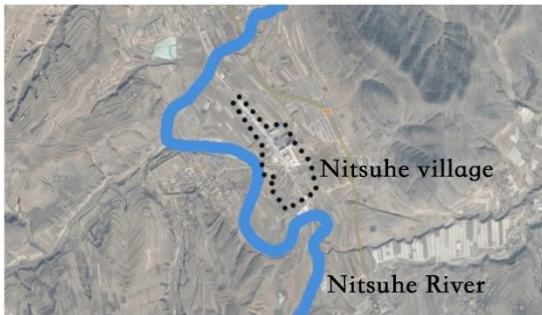

At the macro level, the factors that have a greater influence are the topography and terrain. The traditional villages distributed in the higher terrain are scattered and sparse, while the lower terrain is more concentrated and numerous, so most of the traditional villages are distributed in the valleys with lower elevation and near the water sources; from the micro level, the changes in the height and the degree of gentleness of the topography of the specific area will have a great impact on the distribution of villages in the form of the size of the village on the degree of difficulty of the construction technology.


1.2 River Water Source

Some traditional villages in the Ningxia region seem to be distributed along rivers, while the surrounding villages rely on abundant groundwater or sufficient rainwater to ensure village production and meet the normal demands of daily life (Tian, Ding, & Hao, 2022, pp. 31-33). In the high altitude areas of the southern mountainous regions of Ningxia, rainfall increases with the increase in altitude; rainfall on windward slopes is greater than that on leeward slopes, and rainfall on slopes facing south also rains heavily on the side facing north (as shown in Table 1)

Table 1
Relationship between Villages and Water Systems (Source of chart: Author's self-drawn)

Typology	Location	Village name	Icon
Waterfront	Not only are they relatively close to water sources, but they are also all located where the waterways curve or diverge.	Huangdobao village	
		Ma Chang village	
		Yangjiadian village	
		Dong Fu	

Water Surrounding Type	Immediately adjacent to the water system and mostly located where the water system curves or bifurcates.	North Changtan Village	 <p>North Changtan Village: the Yellow River</p>
		Ma'ohmu Village	 <p>Ma'ohmu Village Qingshui River</p>
		Nitsuhe village	 <p>Nitsuhe village Nitsuhe River</p>
		Tongxin town	 <p>Tongxin town Qingshui River</p>

Water crossing type	Located in a valley location, penetrated by a water system	ink slab village	 An aerial photograph of a region in Ningxia. A prominent blue river, labeled 'Qingshui River', flows from the top left towards the bottom left. To the right of the river, a small cluster of buildings is enclosed by a dashed black line and labeled 'ink slab village'. The surrounding landscape is a mix of brownish terrain and some green patches.
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1.3 Cultivated Land for Production

Since the production mode of traditional villages in the Ningxia region belongs to the agricultural smallholder economy, the location of traditional villages often takes into account the speed and practical convenience of agricultural production. Farming villages are usually located in areas with spacious and open spaces, relatively flat topography, and sufficient sunshine and rainfall.

1.4 Security and Defense

The local people’s consideration of security is also mainly due to the high number of dangerous factors in the outside world. For example, banditry, war, and the rampant presence of wild animals. In addition to the external fence of large fortresses, there are also natural ecological barriers inherent in the mountainous areas of southern Ningxia. Ideal ecological conditions is easy to form a closed settlement environment in the mountains or in the back of the mountains and water.

2. Catering to Spiritual Needs

2.1 Feng Shui Needs of Traditional Farming Villages

When people’s reliance on the natural feng shui concept gradually changed to a longing, they would prioritize those natural environments close to the feng shui theories as the locations for building villages when choosing the location of villages. When some natural conditions do not fit the Feng Shui concept completely, people will take some subjective measures to make up for them and improve them, and they will always strive to achieve the best.

2.2 Ethical Requirements of Confucianism

One of the central concepts in maintaining the social structure of traditional villages is the strict requirement of morality and ethics. Xunzi’s Rites of Passage says: “There are three books of rites: heaven and earth, the book of birth; ancestor, the book of class; and master, the book of governance; to honor the rites, to serve the heaven on top, to serve the earth on the bottom, and to honor the ancestor and master is the book of the rites”. Confucian ethical and ritual ideas and Feng Shui concepts seek to harmonize heaven and earth and the pursuit of human beings to a considerable degree of compatibility. The difference between the main room and the rooms in the courtyard of a traditional village building is a direct reflection of the influence of traditional Confucian ethics.

Table 2

Statistics of Different Villages (Source of chart: Author's self-drawn)

Overall morphology type		Village name	Quantities
ribbon	level striped pattern	North Changtan Village	1
	zigzag strip	Niehe Village, Yangjiadian Village	2
fascicled	ordinary cluster	Ma'ohmu Village, Machang Village, Dong Fu	3
	irregularly fascicled	Inkwell Village, Tongxin town, and Huangdobao Village	3

Building Space Characteristics

Each traditional village in Ningxia region has a strong purpose of choosing to build houses, and this concept of choosing building addresses can be summarized into two aspects according to different needs: one of them belongs to the needs of survival, physiology and safety at the material level; and the other one is the needs of the spiritual level of the people who are in pursuit of development, and who are eager to communicate with each other and believe in each other.

At the macro level, the most influential factor is topography. The traditional villages distributed in the higher terrain are scattered and sparse, while the lower terrain is more concentrated and numerous, so most of the traditional villages are distributed in the valleys with lower elevation and near the water sources; from the micro level, the change of the height and the degree of gentleness of the topography of the specific area will have a great impact on the distribution pattern and scale of the village and on the degree of difficulty of the construction technology.

Some traditional villages in Ningxia seem to be distributed along rivers, while the surrounding villages rely on abundant groundwater or sufficient rainwater to ensure village production and meet the normal demands of daily life. In the high altitude areas of the southern mountainous regions of Ningxia, rainfall increases with the increase in altitude; the amount of rainfall on windward slopes is greater than that on leeward slopes, and rainfall on slopes facing south also rains heavily on the side facing north. As the production mode of traditional villages in Ningxia belongs to the small farming economy, the site selection of traditional villages often takes into account the fast and practical convenience of farming production. Farming villages are usually located in areas with spacious and open spaces, relatively flat topography, and sufficient sunshine and rainfall (Wang, 2020). The local people's consideration of safety is also mainly due to the high number of external risk factors. For example, banditry, war, and the rampage of wild animals across the country. In addition to the external enclosure of large fortresses, the security defense is also the natural ecological barrier that inherently exists in the mountainous areas of southern Ningxia. The ideal ecological condition is that it is easy to form a closed settlement environment in the middle of the mountains or in the back of the mountains and water.

3 Components of Courtyard Space

The research on the architectural level and spatial form of traditional houses mainly focuses on the layout of the courtyard space of traditional houses. It is the combination of functionality of courtyard space that constitutes the richness of the whole space and makes it possible to satisfy the needs of daily life in the courtyard. Ningxia traditional villages in the courtyard in the terrain of flat and open courtyard scale, closed privacy good; terrain undulation changes in the direction of the courtyard of privacy is much smaller (Li,

2020, pp. 36-39). According to the analysis of the actual situation of the local traditional houses, the spatial form of the local traditional houses includes the following elements: the main house located in the spatial axis, the rooms on both sides of the central axis, the ancillary rooms (sundry rooms) located in the secondary composition of the building, the enclosed open building space and the enclosed high courtyard wall.

3.1 Main House

The main room is in the center of the courtyard building space, so it is particularly important. The main house is located in the center of the central axis and is also the most used house in the courtyard space. The main room is also called the upper room, usually used for receiving guests and daily living place, generally will be used to the south and build, also to ensure that there is enough sunlight can enter, the interior will generally be separated into several independent functional space, to meet the different needs of life.

3.2 Compartment

The compartments are generally built on both sides of the center axis of the courtyard, and the angle formed by the compartments and the main house is generally a right angle. The appearance of the rooms is generally modeled after the main house, but there are some minor differences. Influenced by the traditional ritual system, the height of the compartments in Ningxia is lower than that of the main house, and they are smaller than the upper house in terms of width, depth and area. The rooms in Ningxia houses are also used as dining rooms or guest rooms, but according to the different sizes of the building space and the different heights and undulations of the terrain, the orientation and number of rooms are also limited.

3.3 Accessory Room

Generally speaking, it refers to the smaller rooms added on both sides of the main house or compartments, or some low rooms connected with the courtyard gate on one side of the gate. These auxiliary rooms are simpler than other rooms in the courtyard space. The auxiliary rooms or compartments on the side of the main house are mostly used as kitchens, bathrooms or storage rooms. The auxiliary rooms that open to the outdoor area with the courtyard door are usually slightly larger in size. They are mostly used for entertaining guests.

3.4 Courtyard Space

The open space formed in the courtyard surrounded by buildings or walls is called courtyard space, and the degree of openness of this space has a lot to do with the plane composition of the courtyard. If it is surrounded on all sides, the privacy and closure are very strong; if one of the sides is less restrictive, the publicity and openness of the space will be reduced a lot. In the use of courtyard space, local residents usually also plant some vegetation to enrich the landscape of the courtyard space to enrich the ornamental, but also to meet the needs of rich daily activities. The outdoor courtyard space is a transitional space, taking over the connection between the house and the outside world (Luo, 2018).

3.5 Enclosure

Enclosure walls are the walls of residential buildings, and the enclosure walls of courtyards are basically boundary walls used to limit the spatial scope of courtyards. Ningxia local traditional residential street wall, the height is generally controlled between 1.2 and 2.5 meters, the use of blocks of stone stacked randomly, this random stacking method will also be applied to the lower courtyard wall, the higher wall of stability and defense are good, used to limit the privacy of the building space (Gao, 2021, pp. 73-75).

3.6 Courtyard Gate

The outermost courtyard gate of the traditional houses in the region is usually located in the opposite side of the main house located in the street, or some things are sandwiched in the middle of the compartments where they are located, and the main courtyard gate in the local houses in Ningxia is presented in the form of a gate tower with a smaller volume and simple shape. The location of the courtyard gate is also influenced by the concept of feng shui. Because of this idea, the courtyard gate is often set in the southeast corner of the courtyard space and more with the main room of the courtyard facing the same direction.

4 The General Form of Courtyard Space

Ningxia traditional residential courtyard space is a different function of the building monomer aggregation formed, can have a richer space combination form more in the terrain of the mountainous undulation. Spatial coordination and composition of different spaces can be combined with a variety of courtyard forms. The more square spatial form is a common courtyard spatial form both in the southern mountainous area and the northern Sichuan area. In the villages visited and researched, the courtyard space of traditional houses can be summarized into the following four forms (as shown in Table 1). The selection and use of building materials in Ningxia have a great influence on the form of building structures and local regionalization. There are two main structural forms in the traditional buildings in Ningxia region: the first one is based on the wooden frame load-bearing structure, the building external enclosure structure and auxiliary enclosure structure using brick wall, raw earth wall, which is divided into the lifting beam load-bearing structure and sorghum-pillar-ping purlin frame; the second is the lifting beam load-bearing structure, the main load-bearing on the use of artificial brick wall, the building does not need to set up the wooden columns around the building, and it is directly loaded on both sides of the mountain wall. Although the first form can stand the test of time, practicality and high security. But compared to the latter, the timber material, complex technical process, construction costs have risen. Therefore, the second form is mainly used in rural areas of Ningxia.

4.1 Building Single Courtyard Form

The monolithic courtyard form is the most common building form in the local traditional houses in Ningxia, except for a single building without any other matching combination. This kind of traditional residential compound, which is composed of monolithic buildings, has a very good adaptability and can be applied to a variety of terrains. First of all, due to the local village terrain is very diversified this characteristic, but also taking into account this kind of monolithic building occupies a small area, is not need a large open space for construction, so in the traditional village can choose this type of building construction area is relatively abundant; Monolithic building courtyard layout form, can be planned and implemented to meet the local terrain conditions.

The traditional residential buildings in the form of monolithic courtyards have a very small limited form of courtyard space. The most typical one in Ningxia is the residential building in the village of Nithe, which is surrounded by the surrounding walls, and through the enclosed backyard and the newly-built houses, it achieves a common external connection. The functionality of this type of courtyard space is gradually diminishing, and the daily life has been transferred to the newly built houses and courtyards.

4.2 Combined Courtyard

Compared with the single courtyard form, the architectural combination courtyard form has added some other buildings that match with each other, and the arrangement of its location is relatively diversified. In terms of the composition is divided into two cases: firstly, the main house and the mutual matching compartments are built adjacent to each other, in the plane space, the two buildings constitute a certain angle, which is common is the right-angle layout, so the enclosed courtyard space is very spacious and rich in form; secondly, the main house and the mutual matching buildings are opposite to each other in the layout, so this form is common in the courtyard of the house type which is more open, and the degree of enclosure of the courtyard space is The degree of enclosure of the courtyard space is dependent on the building walls of other courtyards, as the enclosing street wall has a strong shielding effect.

The traditional residential houses in the form of “L” shaped courtyards are very rich and varied in the spatial limitation of the courtyard in this layout. The representative “L”-shaped courtyard was summarized during the field visit and research in Beichangtan Village, where the main house and the matching rooms (compartments) are adjacent and perpendicular to each other, and the other two sides are the outer wall of the building or the low courtyard wall piled up with earth blocks. All the local houses are in this form and are scattered in a stepped manner on the side of the main street.

4.3 Triad Form

In Ningxia, the courtyard of the triad form is enclosed by three buildings and one outer wall, and the building occupies a large area. According to the different setup positions of the courtyard entrance door, the layout of the triad form can be divided into the following two types: the first type of building is located in the higher terrain, the wall and the building space surrounded by the courtyard space, the courtyard door is mostly set up on the side of the compartment and is adjacent to the main house, the choice of this position is to obtain interoperability with the external street, and the indoor/outdoor interaction is strong; the second type of building, the triad form has a regular and neat layout, and the overall layout is neat and tidy, and the overall layout is neat and tidy. In the second building type, the layout of the triple courtyard is regular and neat, and the whole building is built towards the sun, facing north and south, with good sunlight orientation, and the courtyard door is set in the direction opposite to the upper room (GUO, ZHAO, & XUE, 2022, pp. 60-64).

In MaYuePo Walled City, the buildings and courtyard space are surrounded by three sides, and the opposite wall of the main house in the courtyard is set up with a gate, which is convenient for daily transportation and contact, and the houses in the whole courtyard are symmetrically distributed, with a neat layout and a strong privacy in the courtyard space.

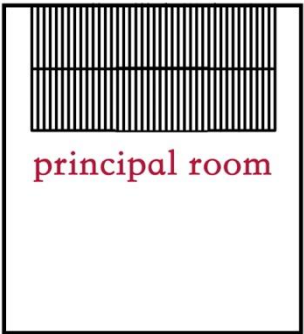
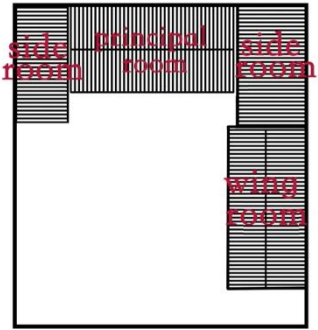
4.4 Courtyard Form

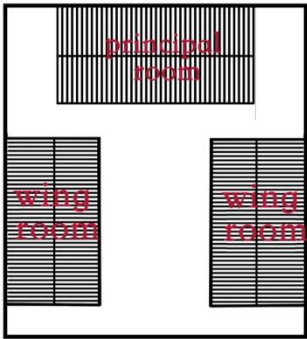

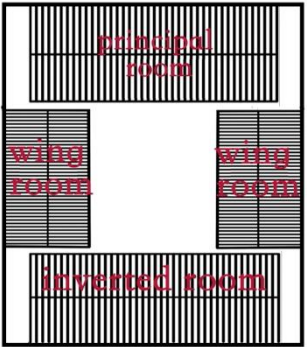

The courtyard is surrounded by buildings on all sides, and it is also the most regular and complete form of courtyard layout in existence. However, there are some conditions that need to be met, first of all, it needs to cover a large area, and secondly, it needs to be relatively flat and spacious in terms of topography and terrain. Therefore, this form of architecture is only used in the higher level of traditional villages. Generally, it is only those who have strong financial resources and prominent status in the village who can build a courtyard, and the courtyard is mostly chosen in a spacious, bright and flat location.

The most representative courtyard houses are the Liu's House in Liangbao Village and the Ma's House in Hongya Village, with the overall layout of the courtyards arranged in a neat and regular manner, and the orientation of the buildings is also north-south, in order to keep sufficient light. The courtyard in Liangbao Village is not as neatly arranged due to the terrain limitation, but the whole is also belongs to the construction form of courtyard. Most of the traditional houses in Hongya Village are located on the flat open space with high terrain, and the courtyard space and the overall scale of the houses in the village are distributed evenly. The choice and use of building materials in Ningxia have a great influence on the form of building structures and local regionalization characteristics. There are two main structural forms in the traditional architecture of Ningxia region: the first one is mainly wooden frame load-bearing, and the external enclosure structure and auxiliary enclosure structure of the building use brick wall and raw earth wall, which is divided into lifting beam load-bearing structure and sorghum-pillar-ping purlin frame; the second one is lifting beam load-bearing structure, and the main load-bearing uses man-made brick wall, and the building does not need to set up wooden pillars around the perimeter of the building, and it is directly loaded on both sides of the mountain wall. Although the first form can stand the test of time, practicality and high security. But compared to the latter, the timber material, complex technical process, construction costs have risen. Therefore, the second form of construction is mainly used in rural areas of Ningxia.

Table 3

Schematic Diagram of Courtyard Space Shape (Source of chart: Author's self-drawn)

General morphology	Spatial characteristics of the courtyard	an actual example
Architectural monolithic courtyard form		
Architectural assemblage of courtyard forms		

Triad form		
quadrangle form		

Conclusion

This paper summarizes the architectural spatial characteristics of traditional residential buildings in Ningxia region, firstly, it analyzes the spatial composition elements of traditional residential compounds on the macro level, and analyzes the architectural spatial composition morphology on the micro level, which are the forms of architectural monolithic compound, architectural combination compound, triple compound and quadrangle compound. Secondly, according to the indoor and outdoor spaces of the local traditional houses, under the influence of the traditional architectural hierarchy, different functional partitions are also formed. The shaping methods and performance characteristics of the space of these traditional houses have good guiding significance for the design of modern architectural groups and monoliths. The study of traditional residential buildings in Ningxia not only facilitates the inheritance of the “Silk Road” residential architectural art in the future, but also makes the regional residential buildings shine in the soil of Chinese residential architecture.

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