

Study of Spatial Characteristics of Streets and Alleys in Traditional Villages: Taking Pingtan Comprehensive Experimental Area as an Example

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Abstract: Taking the traditional residential street space in Pingtan Comprehensive Experimental Area as an example, the factors influencing the formation and development of lane space and the distribution characteristics of lanes were analyzed in this paper. Subsequently, an analysis was conducted on the scale and proportion of street and lane space enclosed in the settlement, the experiential aspects of street and lane space, as well as the node space. Lastly, a systematic summary of the street space characteristics in the settlements of Pingtan Island and Dongxiang Island is presented.

Keywords: Traditional villages; Street spaces; Characteristics; Pingtan Comprehensive Experimental Area

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1. Research background

In recent years, China has been experiencing an increasing demand for urbanization and the integration of urban and rural areas. As a result, the country is confronted with the harsh reality of losing at least one hundred villages every day^[1]. The development of villages plays a significant role in shaping the beliefs and culture of the majority of Chinese people. Traditional villages serve as the carriers of people's beliefs and culture, while traditional dwellings serve as the foundation for the formation and development of villages. Additionally, street and alley spaces serve as the primary venues for daily communication and production activities. These spaces are also vibrant hubs for cultural exchange in villages, characterized by a strong local flavor.

From the perspective of place and crowd organization, there are evident disparities between traditional streets and urban roads. Traditional streets not only fulfill daily transportation functions but also act as venues for interpersonal communication and socialization. On the other hand, urban roads primarily prioritize accessibility during transportation^[2]. At the same time, many scholars have shifted their focus to street space. Duan proposed the concept of spatial genes. Although it has similar main axis arrangements domestically and internationally, it is influenced by regional culture in terms of layout levels, systems, and orientations^[3]. Gao and Zhang have conducted research on street space in mountainous settlements. The former studied and summarized the spatial characteristics and perceptions of four Miao settlements in southeastern Guizhou, while

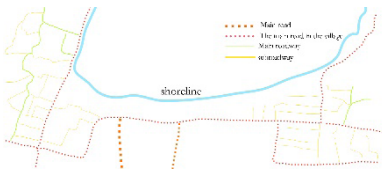
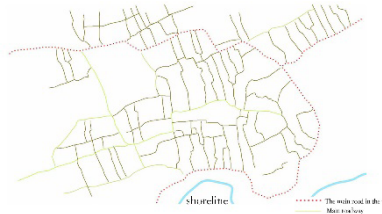

the latter studied the relevance of street space in Guifeng Village, Fujian [4,5].

Pingtán County is situated in the eastern part of Fujian Province, facing Taiwan region across the Taiwan Region Strait, and is renowned as the “Thousand Reef Island County.” Its unique geographical location and natural environment have contributed to the development of a distinctive architectural culture and form. The Pingtan stone houses represent a prime example of traditional houses in Fujian Province. Numerous scholars in China have conducted comprehensive research on traditional villages within the Pingtan Comprehensive Experimental Area, focusing primarily on the transformation design of traditional houses, the identification of village landscape genes, and the protection planning of stone houses. However, there has been relatively limited research on the street and alley spaces within these traditional villages. To address this gap, our study aims to preserve the favorable current conditions and geographical location. We have selected Beigang Village, Junshan Village, Dacuoji Village, Yangmeikeng Village, Baisha Village, and Baisheng Village on the main island of Pingtan, as well as Hubian Village, Aodi Village, Aoxing Village, and Dongxia Village on the subsidiary island of Dongxiang as the research subjects.

2. Street and alley spatial structure characteristics

The distribution of village buildings is not only influenced by the cultural history and ancestral temples in the village, but also by the natural environment. For example, the influence of terrain elevation differences or coastal locations, these natural factors have certain impacts on the distribution of buildings and streets in the village (Table 1).

Table 1. Distribution types of streets and lanes

Types of distribution	Distribution characteristics	Representative villages
Free-style	This type of settlement is limited by the natural environment, and the settlement will change due to changes in terrain or coastline. The density of buildings and the size of streets and alleys will vary depending on the population of the area.	 <p>Woxing Village, Wodi Village, Lakeside Village</p>
Mesh-style	The main roads in the street and settlement intertwine with each other, forming a branching pattern. The main roads serve as the backbone of the entire street network, while the rest of the streets follow its overall direction.	 <p>Baisha Village, Baisheng Village.</p>
Radiating-style	There is a main artery, and the rest of the streets or roads radiate from the main artery. The distribution of alleys is flexible and changeable, and there can be multiple development centers.	 <p>Yangmeikeng Village</p>

2.1. Free-style street layout

The village is situated in a mountainous region with rugged terrain, and the difference in elevation exceeds thirty meters. Some villages are also near the coast, resulting in a development pattern of streets and lanes with a free-style layout. The free-style street and lane settlements in coastal areas are influenced by the natural terrain. Residential buildings are arranged based on changes in elevation, resulting in a flexible overall spatial layout, as well as diverse building orientations and volumes.

2.2. Mesh-like street and alley layout

This type of settlement is primarily found in hilly regions characterized by relatively flat or gentle slopes. The architectural structures within this area are concentrated to maximize land utilization, resulting in a high density of residential buildings. The streets and alleys exhibit a winding and branching pattern, with the main roads serving as the framework of the street network. Secondary streets extend and expand from the main roads, creating a branching street organization that connects the surrounding areas. The main street, which traverses the entire network, dominates the street layout. Additionally, various small paths are interspersed throughout the village, leading to different areas within.

2.3. Radial street layout

This particular type of village is primarily found in plain areas or regions that are relatively flat. The village's structure consists mainly of clusters of groups within the village, which are autonomous but also interconnected, thus collectively forming the overall village layout. The overall layout is characterized by one or more main roads, with additional roads extending outwards from the main roads. This layout shape resembles that of a "fishbone". The distribution of streets and lanes is relatively arbitrary and adaptable, yet it still maintains a certain level of order.














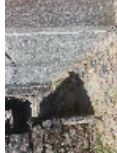


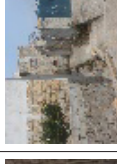
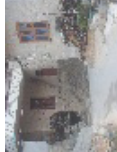
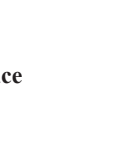

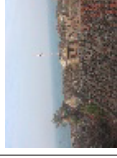





3. Street and lane interface analysis

Space is essentially formed through the interaction between the object itself and the individual perceiving it^[6]. Street space consists of three interfaces, namely the ground, walls of buildings or structures, and covering structures on top of the space^[7]. These interfaces, regardless of their size, material, combination method, or color, have the ability to create a diverse street experience (**Table 2**).

3.1. Street and alley spatial bottom interface

The bottom interface in the village primarily consists of roads, ramps, stairs, ditches, and platforms, which are delineated by continuous variations in paving materials or the enclosure of buildings^[8]. Different types of street and lane layouts exhibit distinct characteristics, with free-style street and lane spaces exhibiting closer connections to the terrain and surrounding environment, resulting in extended and more developed bottom interface spaces. Conversely, grid-like and radial bottom interface spaces exhibit weaker connections with the terrain and environment, highlighting the evident traces of artificial planning. The bottom interface is significantly influenced by the terrain, which can be either winding or flat. Moreover, the bottom interface serves not only as a means to guide traffic but also possesses landscape functions. In terms of material composition, the main roads and street bottom interfaces in the village predominantly employ direct concrete hardening, while some alleyways are adorned with neatly laid cobblestones. A small number of roads remain unpaved or hardened and are directly exposed to bare earth. Additionally, certain road surfaces are composed of a combination of various materials, such as embedding pebbles between cobblestones to enhance the sense of layering and aesthetic appeal of the road surface.

Table 2. Interface composition of street and lane space

		1		2		3		4		5		6	
Type	1	Cobblestone		Cobblestone + cement		Pebbles + cement		Pebbles + cobblestone		Cement		Loess	
Texture	Smooth	Rough		Relatively smooth		Rough		Relatively rough		Rough		Smooth	
Detailed	Roughly laid out	Surface disorderly		Tightly laid out		Scattered laid out		Neatly laid out		Connected as a whole		Weeds on both sides	
Photo													
Type	1	2		3		4		Type		1		2	
Material	Cobblestone	Red brick		Hollow brick		Granite		Material		Tile		Cement	
Texture	Relatively rough	Rough		Rough		Rough		Texture		Rough		Relatively rough	
Detailed	Herringbone or irregular masonry	Regular masonry		Regular masonry		Regular masonry		Detailed		Arc in cyan-black or red color.		Connect as a whole	
Photo													
Bottom interface						Side interface						Top interface	

3.2. Street and alley space side interface

The side interface primarily refers to the composition of the surrounding courtyard walls and the surrounding environmental elements. Due to the influence of the natural environment and geographical location, the utilization of traditional Chinese construction materials such as earth and wood is not suitable for large-scale application on the island. Therefore, island residents utilize locally abundant stone materials for construction and wall building. In free-style streets and lanes, the continuity of street and lane spaces is weaker due to the influence of terrain fluctuations and coastal environments. However, the complex terrain, diverse forms of building walls on both sides, and the rich jointing techniques of building walls provide a visually rich experience.

3.3. Street and alley spatial roof interface

























The top interface refers to the architectural elements that define the boundary between buildings and the sky, including roofs, eaves, gables, verandas, and structures on both sides of streets and alleys^[9]. There are three main configurations of the top interface: the first configuration has no protruding structures obstructing the overhead space; the second configuration has a veranda or protrusion on one side, partially covering the top space of the street or alley; the third configuration has interconnected structures connecting the tops of structures on both sides, completely separating people from the sky, or each side of the structures has verandas that almost completely cover the entire top space. Among these three configurations, the third configuration creates the strongest sense of enclosure.

4. Street and lane spatial scale analysis

The formation of street and alley spaces is a deliberate and purposeful creation resulting from the adaptation and compromise of local residents with the natural environment. According to Japanese architect Yoshinobu Ashihara's discourse on street space and aesthetics, the ratio of width to height (D/H) in streets and alleys serves as the standard scale for spatial proportions, allowing for the study of the interaction between street and alley spaces and individuals^[10]. This article focuses on communication-oriented lanes as illustrative examples, omitting major roads primarily designed for transportation purposes.

The combination forms observed in the streets and lanes can be categorized into five main types: "building + building," "subsidiary building + building," "building + wall," "subsidiary building + wall," and "wall + wall." The different forms of streets and lanes are influenced by various factors such as terrain, hydrology, and culture, which evoke distinct emotions in people. In the layout of streets and lanes with a free-style design, the D/H value of the "building + wall" form tends to be larger, ranging from 0.7 to 1.23. In network-style settlements with streets and lanes, the building density is higher, and the street width primarily falls between 0.8 and 2.5. As a result, the D/H values of different combinations of street and lane forms begin to exhibit varying degrees of decline. Notably, the D/H value of the "building + wall" combination form is 0.11, creating a sense of depression and discomfort among individuals. Similarly, the D/H values of the "building + building" combination form in streets and lanes are mostly distributed within the range of 0 to 0.4, evoking a more oppressive atmosphere. In radial streets and lanes, the street width is relatively wide, and the buildings are typically two-story structures. Consequently, the D/H value of the street space is higher compared to network-style and free-style layouts, resulting in a generally positive and open street experience (**Table 3**).

Table 3. Spatial scale of streets and alleys between different settlements

Settlement	Lakefront Village (free-style streets and alleys)				Dongxia Village (free-style streets and alleys)			
	Building + Building	Wall + Building	Wall + Building	Wall + Building	Building + Building	Building + Building	Wall + Building	Building + Building
Composition	Building + Building	Wall + Building	Wall + Building	Wall + Building	Building + Building	Building + Building	Wall + Building	Building + Building
Profile								
Proportion	0.95	0.70	1.23	1.1	0.50	0.52	0.81	0.45
Feeling	Good	Good	Broaden	Broaden	Good	Good	Good	Good
Settlement	Baisha Village (network-style streets and lanes)							
Components	Subsidiary building + Subsidiary building	Building + Wall	Building + Building	Building + Building	Subsidiary building + Wall	Building + Wall	Building + Wall	Building + Building
Profile								
Proportion	0.5	0.11	0.26	0.16	0.64	0.53	0.5	0.32
Feeling	Good	Suppressed	Suppressed	Suppressed	Good	Good	Good	Suppressed
Settlement	Dacuoji Village (radiating street lanes)							
Components	Wall + Wall	Wall + Wall	Building + Wall	Building + Wall	Building + Wall	Building + Subsidiary building	Building + Subsidiary building	Building + Subsidiary building
Profile								
Proportion	1.18	0.98	0.58	0.45	0.58	0.48	0.39	0.4
Feeling	Broad-mindedness	Broad-mindedness	Good	Good	Good	Good	Suppressed	Suppressed

5. Conclusion

From a cultural perspective, there exists an inherent correlation between the architectural design of ancestral temples and the layout of streets and alleys in villages. This correlation primarily manifests in two forms: encircling and guiding. When it comes to street and alley distribution, this connection becomes more pronounced. From a natural environment standpoint, the distribution of streets and alleys can be categorized into three types: free-style, grid-style, and radial patterns.

Regarding interface composition, notable disparities can be observed between the granite used in lateral interfaces and the traditional civil structures found on the mainland. However, there are no significant distinctions between the bottom and top interfaces. In terms of scale, settlements with a free-style street and alley layout boast the largest width-to-height ratio (D/H), providing individuals with a more spacious and pleasant street experience.

Disclosure statement

The authors declare no conflict of interest.

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