THE REVITALIZATION OF PUBLIC SPACES IN GUANGFU TRADITIONAL VILLAGES BASED ON SPACE SYNTAX: A CASE STUDY OF JIAOYUAN ANCIENT VILLAGE IN ZHAOQING CITY

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Abstract: Guangfu villages, as significant cultural heritage sites in the Lingnan region, possess spatial forms and historical-cultural values that merit in-depth study. However, with the advancement of modernization, the vitality and dynamism of public spaces in many traditional villages have gradually waned, leading to issues such as spatial decay and the disappearance of cultural imprints. The spatial morphological characteristics of villages serve as a crucial foundation for their analysis and study. This paper selects Jiaoyuan Ancient Village as the research subject and conducts field investigations to conduct a detailed analysis of its spatial structure, including road networks, public space layouts, and building distributions. With the aid of space syntax techniques, quantitative analyses are conducted on key elements such as the integration and intelligibility of the village, revealing the internal characteristics and potential issues of its spatial structure. Based on the results of the quantitative analysis, effective pathways for revitalizing the public spaces in traditional villages are proposed.

Keywords: Guangfu traditional village; Space syntax; Public space; Jiaoyuan Ancient Village

1 INTRODUCTION

Traditional villages are formed through the long-term combined influence of various factors, representing a complex and diverse process. As an important component of cultural heritage, they carry rich historical, cultural, and social values. Traditional villages not only embody abundant living cultures but also serve as the spiritual home and repository of nostalgia for people. These living cultures include seasonal celebrations, temple fairs, life rituals, and more, which have been passed down through generations, forming the unique cultural traditions and customs of the villages.

Public spaces in villages are crucial carriers for villagers' daily activities, such as travel and cultural exchanges, and are mutually catalyzed by natural factors of the villages and villagers' living needs [1]. With the rapid development of urbanization, some traditional villages have experienced population outflow and hollowing, leading to the abandonment of a large amount of housing, land, and other resources within the villages. The functions of public spaces in villages, which are intended for social interaction, cultural promotion, and economic activities, have been severely lost, making it difficult for culture to be transmitted and continued.It is thus evident that traditional villages have become difficult to adapt to the current demands of urbanization development, and the development of traditional villages faces unprecedented challenges.

Under the guidance of the "Hundred Counties, Thousand Towns, Ten Thousand Villages Project," the implementation of the "High-Quality Development Project for Hundred Counties, Thousand Towns, and Ten Thousand Villages" has been proposed, with urban-rural integrated development as the main approach to comprehensively promote rural revitalization. The revitalization of village public spaces has become an important measure to promote the construction of harmonious and beautiful villages and facilitate urban-rural integrated development [2].

Based on the above situations, research in this field has gradually garnered attention, especially research on the revitalization of public spaces based on space syntax, which provides a new perspective for understanding and improving the spatial structure of traditional villages. However, existing research primarily focuses on case studies, lacking a systematic theoretical framework and comprehensive research. Further interpretation of culture, enrichment of case studies, enhancement of comprehensive research on cases, and exploration of potential pathways for future development are required.

Scholar Zhang Miaolin has explored in greater depth how traditional villages can better achieve transformation and revitalization in the context of urbanization. Taking Jianbei Village in Gaoping City, Shanxi Province as an example, the author analyzes the contradiction between the functions of public spaces and the living needs of villagers from multiple disciplines such as architecture and urban and rural planning. Through quantitative analysis, the author proposes revitalization approaches such as improving the living environment, beautifying street and alley spaces, and increasing the number of public spaces [3], aiming to restore the vitality of public spaces and promote the revitalization of villages. Notably, scholars Cui Wanyu and Yao Lei conducted quantitative research on the public spaces of Gudiao Village using space syntax theory and Depthmap software. Their research revealed the relationship between the integration of public spaces and village functions, finding that areas with high integration are typically the main interaction nodes of the village, while areas with low integration are mostly private spaces. Their findings emphasize the importance of public space design in promoting social interaction and suggest enhancing village vitality by improving the morphology of public spaces. At the same time, it is also worth noting that, as Xu Bolun et al. studied the narrative spaces of traditional

villages and explored the relationship between space and human memory. By combining space syntax theory with Depthmap software, they analyzed the constituent elements of narrative spaces [4] and proposed suggestions for protecting the narrative spaces of traditional villages, emphasizing the important role of space in cultural heritage. The research underscores the dual importance of conservation and utilization of traditional villages in the context of rural revitalization.

In this context, scholars Che Lu and Peng Huiyun discussed the spatial morphological characteristics of traditional villages, analyzing the "clustered axial" spatial structure of Tielu Village. Through quantitative analysis, they proposed that tourism projects and service facilities should be reasonably set up on the basis of preserving the original spatial form of the village, understanding the historical and cultural value of traditional villages, and rationally utilizing tourism resources to achieve sustainable village development. Scholar Liu Guiran conducted a systematic analysis of the public spaces in Xiongfan Village, pointing out that traditional villages are facing the crisis of destruction of their appearance and loss of vitality in the context of rapid urbanization. Using space syntax tools, he conducted a quantitative analysis of the structure of the village's public spaces, revealing the existing problems and proposing targeted revitalization strategies. [5] The research indicates that the revitalization of public spaces needs to be carried out in combination with the needs of villagers while maintaining the authenticity of the village, in order to maximize their social and cultural value.

Synthesizing the aforementioned literature, current research on the revitalization of public spaces in traditional villages has gradually formed a certain theoretical system and practical framework. Researchers generally adopt quantitative analysis tools such as space syntax to deeply explore the structural characteristics and social functions of public spaces and propose targeted revitalization strategies [5]. Although existing research has achieved certain results in both theory and practice, there is still room for further improvement in the depth and breadth of quantitative analysis. Additionally, future research can focus more on the integration of villagers' needs and cultural heritage to achieve sustainable development of traditional villages.

This study aims to explore the paths and strategies for revitalizing public spaces in Guangfu traditional villages based on space syntax. Specific research questions include: How can space syntax be utilized to study the public space morphology of traditional villages? What contradictions and challenges exist in local socio-cultural and commercial tourism aspects during the revitalization process? By analyzing the case of Jiaoyuan Ancient Village in Zhaoqing City, this study aims to investigate effective public space revitalization strategies to improve the spatial utilization of traditional villages, villagers' cultural identity, and commercial tourism value. Based on the analysis of space syntax, how should traditional villages revitalize and improve their public spaces? This question will permeate this study, providing more innovative paths and strategies for the revitalization of public spaces in traditional villages through syntactic deconstruction.

2 REGIONAL OVERVIEW AND RESEARCH METHODS

2.1 Overview of Jiaoyuan Ancient Village

Zhaoqing City, located in the central-western Pearl River Delta, serves as the core of Cantonese culture. Geographically, it sits in the transitional zone from the mountainous regions of western Guangdong to the plains, where the cultural system and Cantonese dialect are well-preserved. According to statistics from 2010, Zhaoqing boasts 39 traditional Cantonese villages, distributed in diverse locations.

Jiaoyuan Ancient Village, a 600-year-old Cantonese ancient village, is situated at the foot of Dinghu Mountain in Dinghu District, Zhaoqing, on a plain between Dinghu Mountain and Lanke Mountain, covering a total area of 126,000 square meters. The ancient building complex within the village occupies over 1,080 square meters, including Longxi Academy, the Ancestral Temple of Su Zhenren, the Ancestral Temple of the Liang Clan, as well as ancient houses, shops, ancient archways, and stone-paved alleys from the Ming and Qing dynasties. To the south of the village lies Dinghu Mountain, from which water is diverted through bamboo forests into a pond in front of the village, serving the villagers for irrigation, fire prevention, animal husbandry, and daily life. There are two large areas of ancient trees within the village, including 57 ancient trees of national first, second, and third grades, belonging to 13 species.

2.2 Research Methods

Through literature review and data inquiry, we will examine the historical documents, local gazetteers, planning document, and other materials related to Jiaoyuan Ancient Village to gain insights into its cultural history and development.

Utilizing the theoretical analysis method of space syntax, we will employ the Depth Map-Beta 1.0 software to identify the main axes based on the road network and public space layout of Jiaoyuan Ancient Village. We will analyze convex spaces, with specific spatial morphology evaluation indicators including integration values (both global and local), choice values, intelligibility values, and synergy values. Based on the establishment of axis models and segment models, we will draw the axis map of Jiaoyuan Ancient Village in Depthmap to understand the accessibility and connectivity of convex spaces. Additionally, we will conduct a topological analysis of the axis map to explore the connections between nodes and comprehend the degree of aggregation of spatial elements. Finally, we will discuss the agglomeration, convenience, spatial composition of public spaces, and the relationship between public spaces and social activities

based on the calculations of integration, connectivity, and depth values.

3 COMPOSITION AND SPACE SYNTAX ANALYSIS OF PUBLIC SPACES IN JIAOYUAN ANCIENT VILLAGE

3.1 Composition of Public Spaces in Jiaoyuan Ancient Village

3.1.1 Public node spaces

The public node spaces in Jiaoyuan Ancient Village are indispensable components of village life. They exist in various forms and functions throughout the village, providing villagers with abundant venues for public activities.

Ancestral Halls and Squares: The ancestral halls in Jiaoyuan Ancient Village serve as core nodes of the village, fulfilling functions such as sacrifice and assembly. According to statistics, there are three main ancestral halls within the village, attracting over 5,000 villagers to participate in various activities annually. The ancestral halls in Jiaoyuan Ancient Village are not only centers for family sacrifices and assemblies but also important carriers of the village's public spirit. Ancestral halls are often combined with squares, forming open and solemn spaces that host important rituals and daily social activities of the village. This layout embodies the traditional "cosmic schema" of "center, direction, domain, and group," strengthening the cohesion and identity of the village (Figure 1-2).

Figure 1 Liang Family Ancestral Hall

Figure 2 Su Zhenren Shrine

Water Wells and Street Intersection Nodes: As essential items for the daily lives of villagers, the well platforms surrounding water wells naturally become important places for villagers to fetch water and interact. There are a total of 12 water wells and street intersection nodes, with an average daily foot traffic of approximately 50 people per node. Additionally, street intersection nodes, as critical points for traffic distribution, also serve the function of daily social interaction among villagers. Although these node spaces are scattered throughout the village, they are interconnected, collectively forming a network of public life within the village (Figure 3-4).

Figure 3 Water Well

Figure 4 Street Lane

Naturally Formed Leisure Spaces: There are also some spontaneously formed leisure spaces in Jiaoyuan Ancient Village, such as those along riversides, beside streams, and under trees. These spaces, with their unique natural environments and cozy atmospheres, attract villagers to come for rest and entertainment, becoming indispensable public nodes within the village (Figure 5-6).

Figure 5 Rest Space
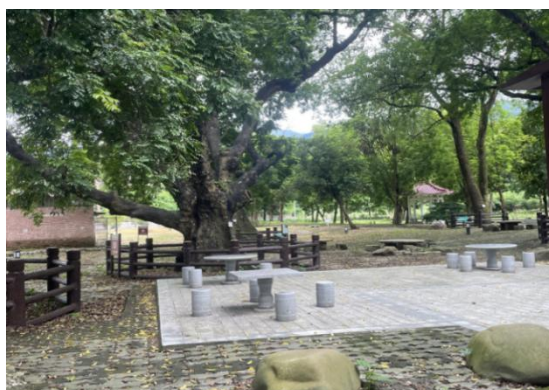
Figure 6 Street Lane

3.1.2 Public linear spaces

The public linear spaces in Jiaoyuan Ancient Village are mainly composed of streets, water systems, and strip green landscapes, which connect various node spaces and form a complete public space system.

Street System: There is one main street and five secondary streets, totaling over 2 kilometers in length, connecting the main public buildings and residential areas of the village. The street system in Jiaoyuan Ancient Village is clear and orderly, with the main street connecting the main public buildings and transportation nodes of the village, while the secondary streets link the various residential areas within the village. The streets are not only pathways for villagers' daily travel but also important carriers for information exchange and material circulation within the village [6] (Figure 7).

Figure 7 Public Linear Spaces

Water System Landscapes: The streams surrounding the village total approximately 1.5 kilometers in length, with three ponds totaling 5,000 square meters in area, providing villagers with abundant natural landscapes and leisure spaces. Jiaoyuan Ancient Village is surrounded by streams and ponds, which not only provide the village with abundant water resources but also form unique natural landscapes. As an important component of linear public spaces, the water system not only serves transportation functions but also becomes an important place for villagers to relax and entertain (Figure 8).

Figure 8 Water System Landscapes

Riparian Greenbelts: There are multiple riparian greenbelt landscapes distributed throughout Jiaoyuan Ancient Village, such as the tree forests along the village edges and the street trees lining the roadsides. These greenbelt landscapes not only beautify the village environment but also serve ecological functions such as cooling and air purification. Additionally, they provide villagers with excellent destinations for leisure and strolling.

3.2 Spatial Syntax Analysis of Public Spaces in Jiaoyuan Ancient Village

After dividing and integrating the public spaces in Jiaoyuan Ancient Village, we translated its alley spaces into axial maps, imported these maps into the Depthmap spatial syntax software, established spatial topological relationships, conducted spatial syntax analysis, and employed quantitative analysis using spatial syntax parameters such as

integration, connectivity, and intelligibility [7]. This approach was used to explore the degree of connection and accessibility between spaces within the village, providing a more intuitive representation of the spatial morphological characteristics of Jiaoyuan Ancient Village.

3.2.1 Integration analysis

Integration is an important parameter for measuring the publicity and accessibility of individual spaces [8]. Spaces with high integration are functionally concentrated areas, indicating that these individual spaces have high centralization and spatial accessibility, and vice versa [1]. Among them, global integration (Rn) represents the degree of connection between a certain space and all other spaces in the system; local integration (R3) refers to the degree of connection between a certain space and other spaces connected within three topological units.

① Global Integration

According to the figure, in the global integration analysis of Jiaoyuan Ancient Village, the obtained "normalized average" is 0.134, with a maximum value of 1.302 and a minimum value of 0.517. The data results show that the village has good spatial accessibility and overall tight connectivity. By referring to the descending order of integration values, we can analyze that the core area is a horizontal region connected by Longxi Academy, Liang Family Ancestral Hall, and Qianguang Kindergarten. Along the axis of this building cluster, the value reaches the maximum of 1.302. As these three buildings serve as the core and spread outward, the axis colors gradually change from warm to cold, i.e., the integration values decrease from high to low, indicating that the degree of spatial aggregation gradually decreases, and the spatial form shifts from concentrated to dispersed. This suggests that the layout of these three core buildings influences the positioning of the core spatial areas within the village.

② Local Integration

Local integration refers to the configurational relationships within local areas of the entire site [9]. It allows for the analysis and extraction of potential core areas within various regions. In the local integration analysis of Jiaoyuan Ancient Village, combined with the local integration map, we can see that the "normalized average" value is 0.446, with a maximum value of 3.643 and a minimum value of 0.333. By referring to the descending order of values, the analysis results show that local integration analysis divides multiple local core areas, corresponding to various traditional building nodes within the village. Comparing this with the global integration analysis, global integration (0.134) is less than local integration (0.446). Furthermore, the warm and cold colors between axes indicate that in Jiaoyuan Ancient Village, the spaces within each core area are tightly connected and have their own organizational structures, respectively forming unique alley road systems for each region.

3.2.2 Connectivity analysis

Connectivity refers to the degree of influence between spaces within the entire street and alley system, i.e., the number of other spaces directly connected to a given space. It reflects the connectivity and permeability between spaces. A higher connectivity value indicates stronger spatial permeability and higher accessibility, whereas a lower value indicates the opposite. [10] In the connectivity analysis of Jiaoyuan Ancient Village, the "normalized standard deviation" is approximately 2.562, with a maximum value of 22 and a minimum value of 1. This indicates that the alley and road systems within the ancient village are intricate and complex, and the intertwined road network enhances the accessibility within the village to a certain extent, providing multiple travel options for people. According to the connectivity map, the values near various traditional ancestral halls and other public space nodes within the village range between 9 and 15, suggesting that the traditional public spaces in the ancient village have strong permeability and high accessibility. Consequently, other spaces within the village can reach these traditional public space nodes, which have gradually become gathering places for villagers.

3.2.3 Average depth value analysis

The average depth value describes the accessibility and convenience of a node within a spatial system, representing the average of the shortest distances (i.e., number of steps) from a node to any other node in the connection graph. It reflects the topological accessibility of a node, i.e., the number of transitions required within the spatial system. A higher depth value indicates more transitions, more complex paths, and lower accessibility and convenience, whereas a lower value indicates the opposite. [11] In the average depth analysis of Jiaoyuan Ancient Village, the "normalized average value" is 59.163, with a maximum value of 370 and a minimum value of 6. From the average depth value analysis map, it can be seen that the roads within the ancient village are intricate and span the entire village. The road system is highly dense, making it easy for tourists and other outsiders to get lost within the village.

3.4.4 Intelligibility analysis

Intelligibility reflects the correlation between local and global variables, using the function y=ax+b (linear regression equation) to simulate the trend of the scatter plot. Here, R^2 represents the goodness of fit. A value greater than 0.5 indicates that it is easier to perceive the overall space from local spaces, whereas a lower value indicates it is more difficult. [12] This expresses the ease or difficulty of establishing an understanding of the overall space through comprehension of the local spatial characteristics within a holistic space. In the intelligibility analysis of Jiaoyuan Ancient Village, the "optimized goodness of fit (R^2)" value is approximately 0.37. Therefore, the optimized goodness of fit for Jiaoyuan Ancient Village is 0.37 < 0.5, indicating that the local spaces within the village are not well integrated into the entire street and alley system. To a certain extent, tourists and other outsiders find it difficult to understand the spatial structure of Jiaoyuan Ancient Village (Table 1, Figure 9).

Table 1 Results of Spatial Syntax Analysis of Jiaoyuan Ancient Village

Integration HH

Value	Attribute
Average	0.878
Minimum	0.517
Maximum	1.302
Std Dev	0.134

Integration HH R3

Value	Attribute
Average	1.906
Minimum	0.333
Maximum	3.643
Std Dev	0.446

Connectivity

Value	Attribute
Average	4.044
Minimum	1.000
Maximum	22.000
Std Dev	2.562

Total Depth R3

Value	Attribute
Average	104.764
Minimum	6.000

	Maximum	370.000
	Std Dev	59.163

Understandability
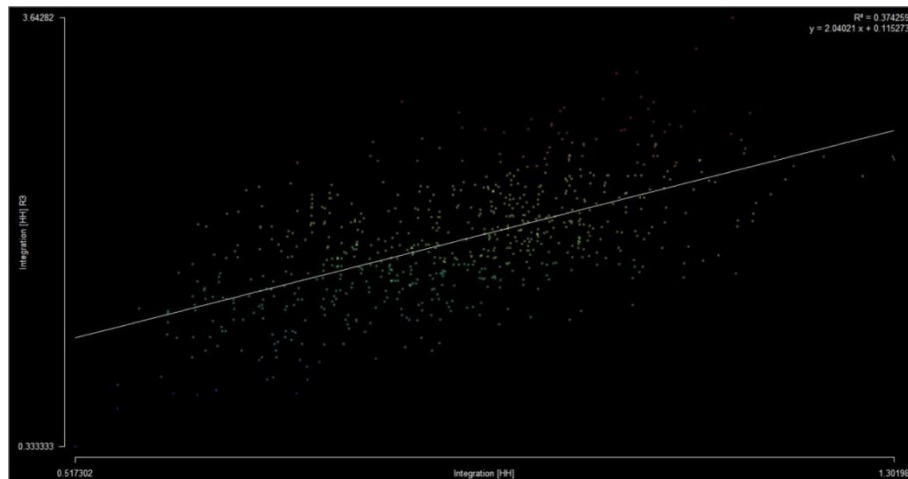
Figure 9 Overall Axial Analysis Diagram of Spatial Syntax in Jiaoyuan Ancient Village

4 STRATEGIES FOR REVITALIZING PUBLIC SPACES IN JIAOYUAN ANCIENT VILLAGE

4.1 Optimization and Revitalization of Pedestrian Spaces and Alley Systems

Utilizing the theory of spatial syntax for an in-depth analysis of the traditional alleys in Jiaoyuan Ancient Village aims to precisely identify high-frequency pedestrian areas. By focusing on revitalizing these areas and strengthening their connections with surrounding spaces, functional spaces suitable for modern life can be constructed. Specific measures include transforming the open space under the ancient banyan tree into an educational green space, optimizing the traffic environment in the old village center, and strengthening the interaction with adjacent ecological farmland. To achieve a harmonious balance between sustainable development and the preservation of traditional features, Jiaoyuan Ancient Village is divided into three major zones: a core protection zone, an infrastructure optimization zone, and a zone for harmonious coexistence between humans and nature. While maintaining the texture of traditional alleys, the infrastructure optimization zone delves deep into cultural genes and historical features to formulate protection measures. Leveraging cultural resources to create unique cultural brands is expected to significantly increase pedestrian traffic in the alley spaces.

4.2 Improving the Village Transportation Network and Living Environment

Through quantitative analysis of the overall public spaces in Jiaoyuan Ancient Village, the shortcomings of the village's external transportation and the fact that its deep-level spatial form and structure are not recognized by the migrant population have been identified, for which corresponding improvement measures should be formulated. These measures aim to enhance the village's transportation convenience, strengthen the industrial and transportation attributes of peripheral village roads and urban trunk roads, and increase the core competitiveness of roads and the convenience of transportation both inside and outside the village, thereby facilitating residents' lives.

4.3 Preserving Village Historic Sites and Preserving Cultural Pulse

Key protection areas and buildings within the village have been identified, and the cultural genes and historical features of Jiaoyuan Ancient Village, such as traditional architecture and legendary stories, have been deeply explored for archiving and preservation. Meanwhile, leveraging the village's cultural resources to create distinctive cultural brands, such as hosting cultural festivals and developing cultural and creative products, not only enhances the village's popularity and influence but also strengthens cultural education and inheritance, fostering villagers' cultural self-confidence and identity.

4.4 Supportive Measures and Villager Participation in Jiaoyuan Village

Jiaoyuan Village offers practical incentive benefits by establishing a special fund to support the infrastructure construction, ancient building restoration, and cultural tourism project development for the revitalization of public spaces in historic villages. Additionally, it actively guides social capital investment into revitalization projects of public spaces in historic villages, attracting more funds and resources into the conservation and development of historic villages through PPP (Public-Private Partnership) models, equity financing, and other means.

To enhance villagers' cultural identity and sense of belonging, the value and significance of Cantonese traditional culture are promoted among villagers through cultural activities and the construction of cultural facilities, fostering their cultural self-confidence and identity. Villagers are encouraged to actively participate in and contribute to the compilation of historical village materials, joining in the revitalization and renovation of public spaces. A preservation and development committee composed of villager representatives is responsible for daily maintenance and repairs.

5 CONCLUSION

Through quantitative analysis using space syntax, this paper objectively and accurately represents the current spatial situation, delves into the issues surrounding the decline in vitality of public spaces in traditional villages, and proposes corresponding countermeasures [13]. The analysis using space syntax focuses on the spatial form itself, while also considering historical, social, and cultural factors. When revitalizing the public spaces of villages, it is important to prioritize the preservation of the integrity and value of village culture, respect the wishes of the villagers, and align with the guidance of the "Hundreds, Thousands, and Myriads Project". By continuing to invest the economic returns from village cultural tourism into village construction, more precise requirements and suggestions can be put forward, providing valuable reference for the revitalization of public spaces in similar traditional villages.

COMPETING INTERESTS

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