Research on preservation and renewal strategies for historic districts under space syntax

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Abstract. Historic districts are an integral part of urban communities, and due to the unique nature of their living heritage, they face the contradiction between preservation and development, necessitating the identification of suitable renewal models and strategies. This study focuses on Sifang Road historic district in Qingdao. It applies space syntax for quantitative analysis of the district's street and alley spaces, including measures of connectivity, control, average depth, comprehensibility, and visual integration. Taking into account the development challenges of Sifang Road historic district, this research explores micro-renewal strategies for the historic district. This study aims to enhance urban vitality, protect and renew historic districts, and demonstrate the potential of using space syntax for urban renewal, providing ideas and methods for the preservation and renewal of historic districts.

1 Introduction

Historic districts represent a dynamic form of urban heritage and hold significant cultural, scientific, educational, and aesthetic values. As integral components of urban stock resources, historic districts carry the city's historical memories, maintain urban fabric continuity, and showcase its charm and vitality, reflecting traditional patterns and historical styles to a great extent [1]. In this context, with a focus on "improving quality and efficiency," the protection and renewal of historic districts are crucial to enhance the quality and conotation of urban development. Space syntax enables the understanding of urban space in its physical, morphological, and social components [2]. It focuses on the topological aspects of urban morphology to estimate the supportiveness of the built environment, elucidating the connection between spatial shape and human behavior in the environment [3]. Based on this, the present study adopts a space syntax perspective, taking Sifang Road historic district as an example to quantitatively interpret the visual space and road topological relationships of the historic district. It interprets the spatial form of the district from the qualitative and quantitative perspectives. It proposes corresponding renewal strategies, providing relevant evidence for the protection and renewal of historic districts and guiding the future development of Qingdao historic urban area.

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2 Method

2.1 Research area

The selected research scope of this paper is located in Shinan District of Qingdao, China. It extends from Cangkou Road in the north to Sifang Road in the south, Zhongshan Road in the west, and Yucheng Road and Liaocheng Road in the east, with a total area of 4.2 hectares. Sifang Road historic and cultural district is situated in the heart of Qingdao city. It is the most essential core area among Qingdao's traditional historic and cultural districts. Well-preserved in its current state, the district is predominantly composed of Li house buildings, presenting a dense architectural texture. . Its main function is residential, with street facing commercial as a supplement, Jimo Road small commodity market is north of the district, while the south is adjacent to a Catholic church (Figure 1).

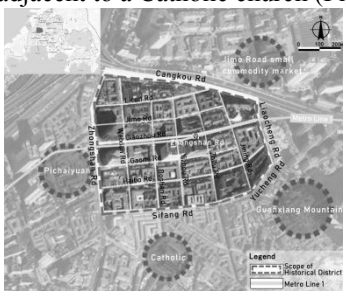


Fig. 1. Map of the scope of Sifang road historic district.

2.2 Syntactic variables

This study utilizes connectivity value, control value, average depth value, integration degree, and intelligibility value from the space syntax model to measure the spatial topological relationships of Sifang Road historic district. A higher connectivity value indicates that many other spaces are connected to that space [4]. The control value reflects the mutual control relationships between spaces [5]. Average depth value refers to the shortest topological distance between a given space and all others [6]. Integration degree is used to measure the level of aggregation or dispersion exhibited by specific spatial units in relation to all other units in the system. Higher integration degree indicates better permeability and accessibility of spatial units [7]. Intelligibility value is used to assess whether the local spatial structure contributes to understanding the entire spatial system, indicating spatial recognizability [8].

3 Spatial characteristic analysis of Sifang Road historic district

3.1 Connectivity analysis

The overall connectivity level of Sifang Road historic district is relatively high, ranging from 5 to 13, and the data on street connectivity values indicate a high degree of concentration. Among them, Zhongshan Road, Sifang Road, Licun Road, Jiaozhou Road, and Jining Road exhibit high connectivity, with Zhongshan Road having the highest axis connectivity value of 13. This indicates that these roads have strong permeability and strong associations with neighboring spaces, fulfilling crucial transportation functions. Significant differences exist in the connectivity values of each street axis, with Weixian

Road and Jimo Road displaying lower connectivity, indicating weaker associations with neighboring spaces and lower spatial permeability (Figure 2a).

3.2 Control analysis

The control value represents the degree of influence of a spatial unit on its adjacent units. In the control value map (Figure 2b), it can be observed that the axis formed by Zhongshan Road, Jining Road, and Zhifu Road exhibits higher control values, which is closely related to the connection of these roads with many other streets within the district. Overall, the control values of north-south oriented roads are relatively higher. In comparison, the control values of east-west oriented roads within the historic district are generally lower, indicating a lower degree of mutual control among these axis spaces.

a.Connectivity b. control

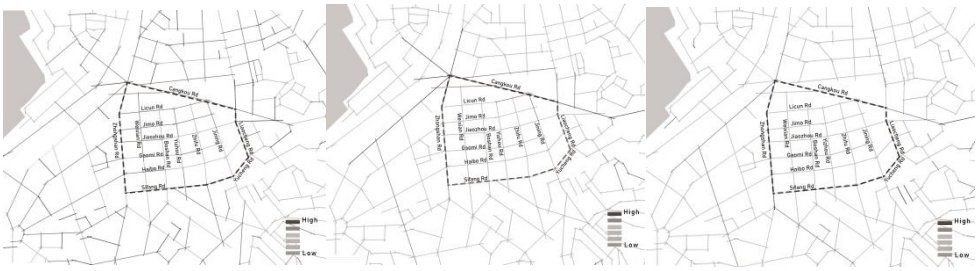
Fig. 2. Connectivity value and control value.

3.3 Mean depth analysis

Therefore, the streets serve as public spaces for people to engage in various activities. The focus of this paragraph is primarily on the average depth value at the pedestrian scale (R_3). The depth value indicates the minimum number of spatial transitions required to reach other spaces within the system. A higher depth value implies greater difficulty in accessing that space. The results of the depth values (Figure 3a) show that the axis lines with lower depth values are mainly located on Boshan Road, Zhifu Road, Haibo Road, and Gaomi Road, which are characterized by higher accessibility as road spaces. Due to the spatial configuration, Licun Road and Jimo Road have higher depth values, resulting in relatively lower pedestrian flow.

3.4 Integration analysis

Figure 3b shows that areas with higher overall integration are concentrated near Zhongshan Road and Cangkou Road, indicating a higher level of accessibility for that street segment, making it the center of the district. On the other hand, Haibo Road, Gaomi Road, and Weixian Road exhibit relatively lower accessibility, indicating poorer spatial accessibility and centrality. This suggests a lower likelihood of being selected as transportation routes. In terms of local integration analysis (Figure 3c), in addition to the existing high spatial centrality and accessibility demonstrated by Zhongshan Road and Cangkou Road, Sifang Road itself, as well as Jiaozhou Road, Boshan Road, and Zhifu Road, which are connected to metro entrances, also exhibit strong aggregation, serving as sub-centers within the district.



a. Mean depth b. global integration c. Local integration

Fig. 3. Mean depth value, global integration value and local integration value.

3.5 Intelligibility analysis

The comprehensibility analysis can be used to measure whether the observed local spatial structure contributes to understanding the overall spatial system. The incomprehensible environment can be explained by the breakdown of cognitive and grouping relationships. The scatter plot shows that the comprehensibility of Sifang Road historic district is approximately 0.709359, indicating a relatively high level of comprehensibility (Figure 4). This suggests that the overall spatial system of the historic district is more easily perceived from the local spaces, with a higher cognitive understanding of the streets, which exhibit a regular form. In the development process of the historic district, attention should be paid to preserving its historical texture and natural forms.

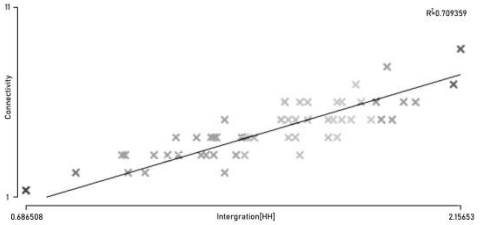


Fig. 4. Intelligibility scatter plot.

4 Result discussion

Based on a space syntax analysis of Sifang Road block, a thorough investigation is conducted into the clustering potential, transportation capacity, and level of accessibility of each street and alley. It is evident that high-integration core areas, such as Zhongshan Road, have the potential to become valuable focal points within the entire historic district. Zhifu Road and Jiaozhou Road also demonstrate relatively good connectivity, integration, and control, with a high concentration of pedestrian flow, indicating a vibrant block. Jiaozhou Road has the highest level of visual integration, with a high degree of spatial openness and visual transparency. However, Licun Road and Jimo Road have high depth values, posing challenges to pedestrian flow and hindering effective gathering and guidance of pedestrian traffic. Furthermore, the street and alley spaces lack attractiveness, requiring optimization and improvement.

Based on the current situation, this study proposes the following strategies to revitalize the Sifang Road historic district. By implementing these strategies, the Sifang Road historic district can fully unleash its potential as a vibrant and captivating public space, attracting tourists and providing them with rich cultural and historical experiences.

1) Each district is developed based on its unique features. For instance, Zhongshan Road, as the main street in the core district with historical characteristics, is designed to shape the urban slow traffic axis. Jiaozhou Road, on the other hand, serves as a leisure promenade, creating a slow-paced axis within the area. Additionally, Haibo Road and Zhifu Road are designated as cultural and creative demonstration districts, highlighting cultural creativity as the main theme. These districts are interconnected, centered around the distinct historical ambiance of Sifang Road, and Haibo Road is transformed into a street representing traditional, time-honored establishments. Furthermore, two prominent districts, namely Weixian Road and Jimo Road, are developed as night market districts, catering to tourists and revitalizing the local atmosphere.

2) The analysis of choice degree in Sifang Road historical and cultural district reveals that most of the streets and lanes within the district suffer from blurred traffic nature and a lack of diverse functional activities, resulting in overall low vitality and insufficient spatial attraction. Therefore, it is possible to precisely position the spatial layout of streets and lanes and carry out corresponding functional expansion and replacement based on their attributes. The units within the Li house buildings feature characteristics such as nested courtyards and small-scale dimensions, displaying a variety of courtyard scales. Based on the existing building depths and courtyard sizes and considering contemporary usage needs, proposals are made for small-scale spaces that match privacy, large-scale spaces that match public nature, and medium-scale spaces that match cultural context, integrating them with the utilization of courtyard spaces.

5 Conclusion

The renewal and utilization of historic districts are crucial for the inheritance of history and the continuity of cultural context in cities, which are influenced by various factors such as natural conditions and social development. Taking Sifang Road historic district as an example, this study employs quantitative analysis and simulation by using space syntax, considering factors such as people's lives, historical carriers, and newly introduced functions. By quantifying the integration, connectivity, control value, depth value, comprehensibility, and visual integration of the historic district, it provides parametric design support for understanding the spatial structure of Sifang Road historic district and serves as a reference for future update strategies. By addressing the existing issues in the district and proposing targeted protection strategies from a sustainable development perspective, this research has achieved the transitions from perceptual behavior to rational thinking in the study of historic districts.

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