Temporal Evolution and Conservation of Urban Morphology in Harbin with Space Syntax

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Abstract (up to 125 words)
Harbin is a city historically shaped by its railway heritage. The construction of the Chinese Eastern Railway, a railway linking Europe and China, has rapidly transformed Harbin from a fishing village to an international metropolis in just half a century. The railway brought expatriates to Harbin, as well as European planning concepts to China. In the process of rapid modernization, Harbin's unique urban form is based on a Western urban texture, overlaid with localized planning ideas. Thus, understanding the historical development and preserving the spatial morphology of Harbin's historic core are key research goals. This research employs the spatial syntax framework to decode the urban axis model of Harbin across four distinct developmental epochs. By quantifying the local integration indices of these axis models, our investigations divulge that the burgeoning expansion of Harbin's urban footprint and the establishment of novel districts have not fundamentally disrupted the historical urban axes. This study contributes to our understanding of urban adaptation and suggests ways to preserve these unique urban features.

Keywords:
Urban morphology, Urban evolution, Space syntax, Characteristic conservation strategy, Harbin historic area

Full text

1.Introduction

For a long time, the protection of cultural heritage and urban development have been in a contradictory, opposing and complex relationship. How to balance development and conservation is an important issue in urban planning and heritage conservation. In 2011, UNESCO formally adopted the Recommendation on Historic Urban Landscapes (HUL), which proposes to perceive the heritage objects from the perspective of value linkage and historical stratification. It expands previous perception of heritage and points out a new direction for historical conservation.

Historic districts are predominantly situated in city centres, reflecting the unique interplay between natural geography and the city's historical and cultural traits. These districts embody the tangible results of social change, economic growth, and local cultural developments.

Consequently, an in-depth exploration of the laws governing the amalgamation of urban space and its evolutionary traits is crucial for the preservation of historical continuity and the scientific protection of historic urban areas.

Since the advent of typomorphology, urban characteristic studies have embraced spatial and temporal dimensions. Spatially, it is posited that complex urban spaces are composed of specific morphological units. Analyzing these units from local to global scales provides insights into the structure and characteristics of the space. Temporally, emphasis is placed on the evolutionary processes of phenomena, deconstructing the relationships between space and societal and cultural dynamics through a historical lens. This approach helps reconstruct the logic of fragmented forms to elucidate the historical evolution of urban spaces.

The theory of space syntax, pioneered by Professor Bill Hillier, is instrumental in quantitatively analyzing urban space networks. This theory uses the human aspects of urban spaces as a lens to assess the connectivity and integration of these spaces, thereby enhancing our understanding of the relationship between societal structures and spatial layouts. Applying space syntax in preserving historic areas and their morphologies is an effective method. Time is a critical element in analyzing regions' characteristics and developmental patterns.

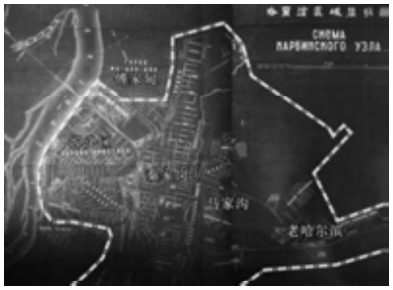
This study employs the space syntax methodology in the historic district of Harbin, which exhibits distinct spatial morphology characteristics. The research questions are: 1) What are the urban morphological characteristics of Harbin with the logic of historical time? 2) What are the evolutionary laws of spatial morphology at different historical stages under the quantitative model? 3) In the face of the existing urban morphology, how should future urban planning be controlled to protect the spatial characteristics of the city?

2.Methology

2.1 Site and case

Harbin, located in the north-east of China, is a city born because of the railway, and it took only 50 years for Harbin to become an international metropolis from a small fishing village. The spatial structure and form of Harbin reflects the modern international planning ideas and strong colonial atmosphere, which is a historical witness of the vicissitudes of the city and a typical practice of modern planning concepts.

The scope of the study is the historical urban area of Harbin (Fig 1) . It is a area that reflects the city's early planning and construction idea This also covers the "Historic District" as defined in the Harbin Historic City Protection Plan.



a. Early Chinese East Railway Dependencies Range

b.gaze to the research scope

Fig.1 Research case

2.2 Historic urban morphology materials

The construction of the CER in 1898 was an opportunity for Harbin's urban development. Many foreign engineers and workers gathered here to form the first urban area. Since then, the prototype of Harbin's modern city began to unfold. Subsequently, multiracial people gathered here and constructed their own ideal space, forming a unique urban form and architectural style, which made Harbin win the "Paris in the East" titles.

According to the historical news and the ownership of the city management, the urban development of modern Harbin can be divided into "1898-1932: the period of Tsarist construction and influence", "1932-1945: the period of Japanese construction and management", "1945 to the present: the period of modernisation and development". Therefore, based on the available historical map resources, 1932, 1946, 1975, and 2018 were selected as four-time slices to quantify the urban form.

Fig2 City maps of four development periods

2.3 Data collection

A line shape file is created in ArcCatalog, and the roads are extracted from the planning drawings or satellite maps of the four periods to form the axial maps of each period as the primary data of the model. In this paper, the DepthMap software platform is used to analyse the spatial shape, and the spatial shape features are discovered through the statistical analysis of several parameters, such as connection value, integration degree, comprehensibility and synergy degree.

3.Results

3.1 Characteristics of early urban planning

Streets are an essential part of urban space. Its planning and construction not only reflects the development stage of the city, but also influences the organisation of social activities and residents' way of life. The form of Harbin road network is influenced by planning ideas and regional functions, adopting an ideal and existence of regular geometric form, common layouts are square grid type, circular, radial.

In the early period, port area road construction in line with the Songhua River and railway line alignment, the formation of diagonal grid layout. After the opening of the port, Qinjiagang in the new railway station lot formed a combination of square grid, radial and fan-shaped network of road forms, baroque formalism style. During this period, the city was divided by the railway to form clear zones, and the road construction within each zone was gradually improved.

The structure formed during this period was the prototype and foundation for the formation of the city of Harbin. The railway station is located in the city's centre and connects the two districts. The city's landmarks and churches control the centre of gravity of the two zones. The urban planning was based on the railway, with clear functional zoning, centred on St. Nicholas Square in Qinjiagang (now Nangang District), with Dazhi Street and Hongjun Street as the cross-axis, of which Hongjun Street extends southwards to connect with Old Harbin (now Xiangfang District). In the port district (now Daoli District) to the Jingwei Street as the central axis connecting the dock and railway station, and derivatives of the branch to the riverside for the secondary axis, the Central Avenue. The axes of the two districts are linked by the railway station, reflecting the main nature and function of Harbin in the city's early days.

Fig.3 Characteristics of early urban planning

3.2 Evolution of urban form

From the quantitative results of the spatial syntax, the axes of the historical urban area are stably inherited and prominent (fig.4).

Referring to the topological principle, the local integration degree of the urban axis model is calculated by the spatial syntax to extract the axes of the urban area at four different development stages. The results of the analysis show that the expansion of the city and the construction of new districts did not have too much impact on the axes within the historic urban area and that Nangang District developed east-west at the beginning of the construction with Dazhi Street as the central axis, and then gradually added several roads perpendicular to Dazhi Street as the auxiliary axes of the spatial development structure. The spatial axis of the historical urban area in Dori is stable, with Jingwei Street and Central Avenue, and the commercial activities in the urban area are carried out accordingly. The urban axis's stability reflects the spatial pattern's stability to a certain extent.

The results of the spatial syntax analysis show that since the Japanese colonial period, the degree of integration of the north-south axis of Hongjun Street has gradually weakened. In contrast, the east-west axis of Dazhi Street has strengthened. At the same time, the degree of integration of the road appears to be higher in the west and lower in the east, which shows that the city of Harbin has leapt forward to the west in the direction of development. From the colonial period to the eve of reform and opening up, Nangang and Dawri historical city roads in the average integration of a significant increase in urban axes also occurred a reasonable increase, which is Harbin in the "First Five-Year Plan", "Second Five-Year Plan" period of the country's key industrial projects, the city to the industrial as an opportunity for development and construction. Industry as an opportunity for development and construction is closely related. After entering the modern period, the city expanded around the central city in a dense and orderly manner. The large-scale road grid surrounded the historical city. Nangang District increased the number of sub-axis perpendicular to Dazhi Street, such as the education street, Haicheng Street, Gogol Street, etc., which is closely related to the construction of large-scale municipal facilities such as bridges and underground passages.

Secondly, the planar texture of the landscape corridor is preserved, but the sense of spatial place is weakened, and genes are hidden. In the process of urban modernisation and development, a large number of high-rise buildings have changed the spatial scale of the original streets, lacked a sense of order and blocked the view corridors so that these contrasting spaces are not well presented and have a low recognition in the urban structure, such as the contrasting corridors of the Beixiu Square and the railway station. In addition, the destruction of landscape nodes and the change of function also led to structural invisibility, such as the disappearance of St. Nicholas Church and the change in the functional nature of the Correctional Square, which weakened the structure of the triangular-shaped square in Nangang District.

fig.4 Evolution of urban form

3.3 Urban planning control strategies

The planning idea of Harbin's early garden city and the unique form of the road network have created a wide variety of view corridor in the city. The recognisability of the linear pattern in the city usually comes from the spatial perception of the residents. Therefore, the protection of the axes and corridors in the historic urban area should be based on visual guidance, construction control, restoration and shaping of a distinctive urban image.

The linear pattern of the Harbin Historical Centre is preserved, and the form of the city roads and squares is still present, which provides the basis for strengthening its spatial characteristics. The enhancement of the linear pattern in the city is divided into two aspects: one is to control the capacity of the historic city based on the visual landscape, focusing on the visual landscape of the central historic nodes and the visual landscape of the axial roads.The other is to sort out the street interface of the axial space, including the improvement of the street façade and street greening. It is expected that through the combination of the two, the urban axes and landscape corridors will be clarified to enhance the recognisability of the spatial characteristics.

In terms of architectural capacity control, through the study of the different psychological feelings generated by different visual distances and angles between people and the built environment, the height of the background environment of the architectural groups at the central historical nodes and the height of the buildings on both sides of the axes and roads are controlled, to shape the landscape characteristics of the historical space. First of all, when

viewing architectural details, the angle of elevation of 45° is the best viewing angle; when viewing architectural groups, the angle of elevation of 18° is the best viewing angle, which is projected to meet the D/H≤1 and D/H≤5 spatial scales of the street when viewing historical buildings and groups of historical buildings, respectively (see Figure 5-b). For example, when controlling the capacity around Central Avenue, in order to strengthen the architectural form of the axial interface, the background height should satisfy H ≤ D. The red line of Central Avenue is 15m, so the height of the new buildings along the street should be lower than 15m in principle, and the height of the background buildings should be increased according to the distance from the centre line of the road. Secondly, according to the scale of the street outline in the urban area, the building height restriction conditions outside the road red line are determined (see Figure 5-c). On both sides of the urban main road, the upper limit of height control is 16m in the range of 100m outside the red line of the road; the upper limit of height control is 24m in the range of 100-200m; and the upper limit of height control is 50m beyond the range of 200m. On both sides of the urban secondary road, the upper limit of height control is 12m in the range of 50m outside the red line of the road; the upper limit of height control is 24m in the range of 50-100m; and the upper limit of height control is 50m beyond the range of 100m. In summary, the above analysis results in the building height control map of the historic urban area (see Figure 5-a).

Regarding street interface management, the control of the road red line is changed to the overall management of street space. Existing planning, design, and specifications for the road red line within the cross-section, municipal and landscape requirements, and the lack of both sides of the building interface and open space are the overall considerations. Therefore, based on restricting construction activities within the red line of the road, the building interface should be regulated, including all kinds of illegal private construction and plaques protruding out of the road, to ensure the smoothness of the sight line within the corridor. Coordinated planning of street green space facilities, open space, activity facilities, etc., to meet the traffic capacity demand and promote the integration of street and neighbourhood development. Restore the early Harbin street greening forms, such as street gardens, courtyard greening, etc., beautify the axes and revitalise the corridors to achieve the role of pedestrian flow guidance so that the connecting paths of the historical elements in the urban areas of the recognisability of the overall linear pattern to strengthen the overall pattern.

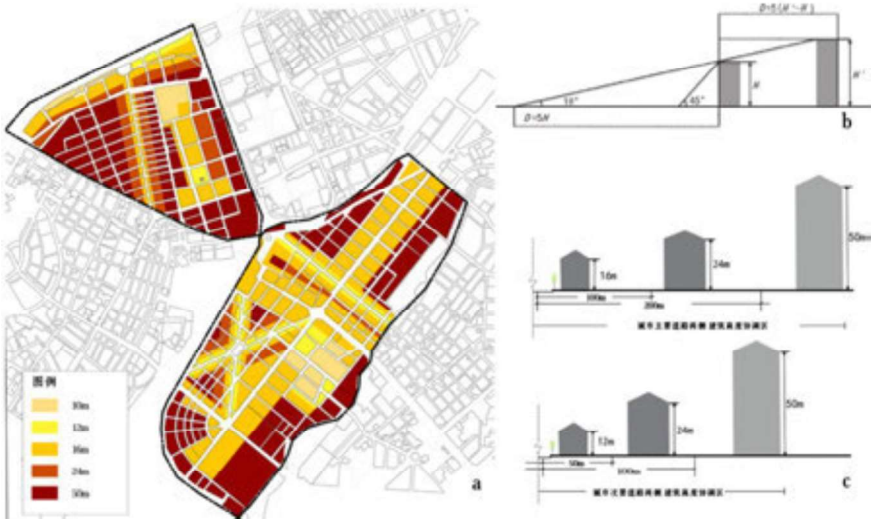


Fig.5 Urban controlling stratigies

4.Conclusion

Spatial characteristics in historic districts represent the systematic combination of spatial elements, shaped by historical stratification and embodying profound spatial meanings. This paper adopts a historical perspective, using space syntax as a quantitative tool to analyze Harbin's urban morphological characteristics and evolutionary patterns. Given the current urban form, this study suggests focusing on two main aspects for future urban planning and preservation: controlling the intensity of building constructions and clearing streets.

The proposals aim to achieve a scientific and sustainable approach to the preservation of the spatial characteristics of historic districts. By employing space syntax, we can effectively quantify and understand the complex interplay between Harbin's historical timeline and urban space, offering a strategic basis for preserving the city's unique architectural heritage and texture. This approach not only ensures the protection of significant historical elements but also facilitates the functional modernization of the city, balancing heritage conservation with contemporary urban demands.