



Research on the Optimization Strategy of Highway Service Area Architectural Design under Regional Culture

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Abstract. In the face of the urgent need for the development and transformation of highway service areas, regional culture serves as an important breakthrough and direction for quality improvement. Presenting the main design form of architecture with regional characteristics, allowing the reproduction of traditional regional culture and form, is an important issue. This paper takes the integration of regional characteristics in the main body of the Wuda High-Speed Service Area as the core content for discussion, extracts the architectural cultural elements of the Dawu area, and carries out the upgrading of the service area architectural design around this core element, forming a traffic commercial body with strong recognition and lasting momentum. Introduction

Keywords: regional culture; highway service area; architectural design; optimization strategy

1 Introduction

The development of China's highway-related facilities has mainly gone through the early "introduction and reference" stage, the mid-term "gradual improvement" stage, and has gradually entered the "transformation and improvement" stage after 2014 [1]. After a long period of construction, the basic supporting facilities of China's highway service areas can meet the basic requirements. However, in the design, the focus is mainly on its traffic functions and superficial environmental beautification decorations. The important role of traditional history and regional culture in public space is often neglected, leading to a serious homogenization phenomenon in the external form and cultural expression of many public spaces [2]. This is also the main reason for the lack of diversity, ecologicalization, artistry, and individuality in the construction of service areas, and the construction is relatively backward, which needs to further improve the environmental quality of the service area. However, applying cultural theory to local development is very important [3]. In recent years, national and provincial levels have been continuously introducing new policies to improve the environmental quality of highway service areas. In 2022, the State Council, the Minis-

try of Transport, and the Hubei Provincial Department of Transportation successively issued the "14th Five-Year Plan for the Development of Modern Comprehensive Transportation System," the "Highway 14th Five-Year Development Plan," and the "Hubei Province Highway Development 14th Five-Year Plan Notification," among other opinions and methods, which proposed to create a number of characteristic highway service areas according to specific circumstances in different regions, and to build a series of demonstration projects for ordinary national and provincial trunk highway service areas. From the development focus, the "quality improvement and efficiency enhancement" of highway service areas is taken as an important direction for the development of transportation. It is very necessary to integrate regional culture into the design of highway service areas to make its design distinctive.

2 Project Overview

The Wuhan-Dawu Expressway is one of the 14 radial highways in Wuhan City approved by the People's Government of Hubei Province in the "Hubei Provincial Highway Planning Outline (2011-2030)," and has been included in the "Hubei Province Comprehensive Transportation Development 13th Five-Year Plan Outline" and the "Hubei Province Regional Development Layout Transportation 'Hard Connection' Three-Year Action Plan (2022-2024)." It is one of the provincial government's "post-epidemic revitalization three-year action plan" projects. The Wuda Expressway is also an important traffic channel for the integrated development of Han and Xiao, with a total length of 126 kilometers. The starting point is located at the Wan Jia Zui roundabout on the Xinshi Road in the north of Hankou, Wuhan, and turns northeast from the south of Yao Jia Ji Street in Huangpi District, deviating from the provincial road S108 to the north, along the front of the mountain, passing through the Hekou Town, Sigu Town, Lvwang Town, Huangzhan Town, and Xuanhua Shop Town in Dawu County, and finally ending at the north of the E-Yu provincial border in Xuanhua Shop Town, Dawu County.

The Xuanhua Shop Service Area's east and west areas are located at the end of the Wuda Expressway, with a net land area of 40,000 m² (about 60 acres) for each, totaling 80,000 m² (about 120 acres), with a total construction area of 7,948.64 m² for both areas, a total building area of 7,521.76 m², and a total green space area of 16,872 m². The focus of the environmental quality improvement of the Wuda Expressway project is the main building of the Xuanhua Shop Service Area. The main buildings on both sides of the Xuanhua Shop Service Area have been basically completed, but due to insufficient understanding of the regional cultural connotation and lack of extraction of cultural genes, the artistic materials presented are scarce, resulting in an architectural style that is not distinctive. Such a service area is difficult to form a unique memory point and is also difficult to play the role of "window" for displaying and promoting regional culture, so it is necessary to further optimize its architectural design.

3 Regional Cultural Analysis of Wuda Expressway Service Area

For a long time, the unique regional culture has been shaped by various factors such as natural geographical environment, climate conditions, social and economic conditions, race, and social structure. These cultural elements are extracted and transformed into visual images to carry the essence of culture and artistic accumulation that has been passed down for thousands of years, not only having a unique visual impression but also possessing a simple and natural aesthetic. Based on the visual isomorphism of regional culture and modern design, a service area with regional characteristics is created to express the aesthetic imagery of regional feelings. A service area with strong regional characteristics not only increases its uniqueness and charm value but also enriches the cultural connotation of the highway. Therefore, the analysis of regional culture in the environmental quality improvement of the Xuanhua Shop Service Area is particularly important.

3.1 Understanding of Regional Culture

Regional culture refers to the characteristic culture that has been precipitated and inherited through history in a specific area and still plays a role today, covering the ecological, folk, architectural, and other cultural expressions of the region [4]. Through interaction and adaptation to the environment, it has formed its unique regional characteristics. Overall, regional culture is mainly composed of "natural elements" and "human elements". "Natural elements" serve as the foundation for the existence of regional culture, forming the main basis of human action space, mainly including topography, flora and fauna, climate, etc. At the same time, "human elements" are created by humans in the production and living activities in the natural environment, and are the results of the use and transformation of natural elements. They are also the embodiment of the natural influence on humans and the ideological concept, usually including aspects such as historical culture, traditional customs, and ethnic customs [5]. Natural and human factors are interwoven and inseparable in the long-term mutual influence and co-evolution, including both material forms of natural and human elements, as well as intangible forms of cultural connotation and social significance. These elements jointly affect the formation and development of regional culture, and their importance cannot be ignored.

3.2 Extraction of Regional Culture

Dawu has a variety of topographical features and historical traces, forming a rich regional culture. Among them, the human elements are particularly prominent in traditional architectural culture. This paper mainly optimizes the appearance of the service area's building design by extracting local architectural cultural elements.

In the architectural culture, Dawu has many traditional characteristic Northern Hubei residential villages, such as Ba Zi Gully and Jiu Fang Gully. The layout of the

building plane usually adopts a symmetrical way along the axis, presented in the form of one or several horizontal courtyard axes. In the group combination form, the skywell courtyard is usually used as the core space for the organization of closed courtyards, which increases the longitudinal and horizontal combination of the courtyard unit. At the same time, these courtyards are also interspersed with alleyways and corridors, forming an overall plane layout, making each household interconnected and each courtyard connected.

The building roofs are mostly hard mountain with small green tiles, featuring clear water ridges and simple, undecorated ridges. Eaves are designed with overlapping bricks in two styles: flat water overlapping and corner overlapping. Exterior walls are blue brick infill with sand and stone for insulation, often with small or no windows. Doors come in three types: gatehouse (with local characteristics, ventilation openings, and brick/stone carvings), door cover (simple blue brick with imitation wooden eaves), and partition doors (six doors with Ruyi and square lattice designs).

Window decorations include eaves ventilation windows (polygonal or square wooden grids), stone leakage windows (polygonal or floral lattices in embroidery courtyards), and threshold windows (simple lattice designs on main hall walls). Northern Hubei folk houses also feature intricate wood and stone carvings, reflecting local aesthetic and cultural values. Decorative elements are concentrated on entrances, gable walls, lintels, beams, and purlins, with wood carvings appearing on windows, beams, and auspicious cloud designs, while stone carvings are found on lintels and column tops. Regional Cultural Analysis of Wuda Expressway Service Area

3.3 Analysis before Architectural Design Optimization

According to the design scheme before optimization (Figure 1), there are deficiencies in aspects such as architectural form, color, materials, doors and windows design, and landscape design. In terms of architectural form, the roof design lacks a deep understanding of Dawu's architectural culture, and the ridge style is single, with the ridge head and eaves overlapping effect not obvious, making the overall roof effect lack a sense of heaviness, and the facade presents a "top-heavy and bottom-light" effect; in terms of architectural color and materials, a large area of white solid walls and gray tiles are used, making the appearance of the building appear monotonous and uncoordinated with the surrounding environment, and its style tends to be the typical Hui-zhou architecture of "white walls and black tiles," showing a lack of Northern Hubei regional architectural style or even inconsistent with the situation in Dawu; in terms of doors and windows design, the window size has not been planned and unified, resulting in a large difference in the size of the upper and lower floor windows and doors, making the facade shape appear messy, uncoordinated, and lacking in rhythm, and the door details are insufficient, appearing rigid. In terms of the main entrance design, the main entrance is relatively small compared to the overall facade scale, resulting in insufficient momentum of the building as a whole and the lack of the corresponding name of the service area weakens the building's recognizability.

3.4 Architectural Optimization Concept and Measures

In the design of modern highway service areas, it is appropriate to use traditional regional architectural symbols, forms, or symbols, forms, colors, materials, and technologies of local landmark and representative buildings, which not only inherits regional culture but also makes the service areas on both sides of the highway more personalized, regional characteristics, and recognizability.

The main body of the Xuanhua Shop service area has been basically completed, and the adjustment space for the housing part is limited, so the main focus is on optimizing and adjusting the existing building facade, re-implanting regional characteristic elements into the design of this project's housing engineering. The optimization design refines the traditional Northern Hubei residential "solid enclosure, hard mountain wall; clay sculpture eaves decoration, Ma Tou changeable" architectural features, and combines with the modern architectural simple design style, using different construction forms, material applications, and spatial expressions to develop into the architectural style of "new Northern Hubei residential." By emphasizing the details of the gable eaves, changing the size of the main entrance of the building, the size of the doors and windows, and adding detailed carvings, the regional characteristics of the building are completed. Therefore, when designing, it is necessary to adapt to the natural conditions on the one hand, and also pay attention to the integration of regional cultural elements, in order to achieve a rich sensory experience effect of the building.

In the original design of Xuanhua Shop, the roof ridge and eaves were overly simplistic, lacking detailed design. This affected both aesthetics and functionality, such as rainwater drainage and waterproofing. To address this, the design was optimized by adopting traditional ridge styles from Dawu's residential architecture (e.g., wandering ridge or clear water ridge) and integrating Hubei Northern-style gray sculptures into the ridge lines. The eaves were enhanced with patterned decorative lines. These changes refined the roof design, adding weight and emphasizing the building's importance while aligning with the regional context. The white solid walls on the facade were too abrupt, overemphasizing Huizhou architectural style without highlighting Dawu's cultural characteristics. This was resolved by adding murals with regional cultural themes, such as Dawu's landscapes or Jiangnan scenery, enhancing the building's cultural atmosphere and blending it into the surroundings.

The inconsistent sizes of upper and lower floor door and window openings were visually unappealing. This was fixed by adopting traditional Dawu-style wooden grille windows with uniform sizes across floors, improving the building's overall coordination and richness. The main entrance lacked identification and had disproportionate beam and column sizes. To enhance its appearance, the service area name was added above the entrance, wooden carvings were applied to the beam, and wood grain material with stone bases was used for the columns. These measures made the main entrance more recognizable and aesthetically pleasing. Overall, these optimizations made Xuanhua Shop's facade more attractive, iconic, and in line with Dawu's regional culture and folk characteristics (Figure 2).



Fig. 1. Pre-optimization exterior of Xuanhua Shop



Fig. 2. Perspective view of the comprehensive building of Xuanhua Shop after optimization

4 Conclusion

The presentation of regional cultural characteristics in architectural design requires a focus on local regional architecture, humanities, and natural conditions, exploring their essential connotations, and condensing and refining the characteristic cultural elements for appropriate presentation. The construction design optimization of the Wuda Expressway Service Area is deeply rooted in the regional cultural attributes of Dawu, thus making a reasonable and distinct personalized expression, focusing on the adaptation to Dawu's architectural culture and climate and its regional expression. By reasonably translating and applying the architectural elements in Dawu's regional culture, it conveys the regional characteristics of modern transportation architecture. This not only improves the environmental quality of the service area but also attracts more users, thereby bringing greater commercial value to the service area.

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