

RESEARCH ON THE SPATIAL STRUCTURE CHARACTERISTICS AND CULTURAL LOGIC OF THE BUILDINGS IN GAOTAI RESIDENTIAL AREA*

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Abstract

As a representative traditional residential settlement in Kashgar, Xinjiang, the Gaotai Residential Area embodies the long-term interaction of terrain, climate, social life, and local building knowledge. Based on field observation, image documentation, and literature review, this study examines the settlement from three closely related aspects: macro site-selection and settlement pattern, spatial organization including vertical stratification and public-private transition, and the cultural logic and ecological adaptability embedded in its architectural space.

The results correspond directly to these objectives. First, the macro pattern of the settlement is shaped by the loess-cliff landform and the urban edge condition, forming a stepped and compact texture that follows contour lines and controls access. Second, its spatial organization combines vertical layering, dense neighborhood units, and graded transitions from alleys to porches and courtyards, thereby improving land-use efficiency while supporting everyday

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interaction and privacy. Third, the architectural space expresses Uyghur family life and religious practice while responding effectively to the arid climate through thick earthen walls, narrow shaded alleys, natural ventilation, and locally adapted construction techniques. The study shows that Gaotai is both a culturally meaningful and ecologically responsive dwelling system, and it provides a useful reference for heritage conservation and regional architectural design.

Keywords: Gaotai Residential Area, Spatial Structure, Architectural Characteristics, Cultural Logic, Ecological Adaptability, Kashgar

Introduction

The Ancient City of Kashgar is an important cultural node on the Silk Road, and the Gaotai Residential Area, located on the loess high platform at the southeastern edge of the old city, is one of its most representative traditional residential communities. With a history of more than six centuries, this settlement preserves a dense and highly adaptive residential fabric that differs from both the courtyard houses of the Central Plains and the mobile dwelling traditions of other ethnic groups in Xinjiang.

Its architectural value lies not only in its visual form, but also in the way space responds simultaneously to geography, climate, and social life. The settlement developed under conditions of drought, strong winds, and large day-night temperature differences, and it also had to adapt to a terrain pattern characterized by a high south, a low north, and deeply incised ravines. At the same time, its spatial organization had to support the Uyghur way of life, especially family cohesion, privacy, and religious practice.

Existing studies on Gaotai have mainly discussed cultural meaning, settlement history, conservation, and tourism development. However, relatively few studies have systematically examined how spatial form, cultural demand,

and ecological adaptation are coupled in the built environment. Therefore, this paper focuses on the architectural spatial structure of the Gaotai Residential Area and explores how its spatial order was formed, how it functions, and what cultural logic is embedded in that order.



Figure 1 The Gaotai ancient houses from the northeast perspective.

Source: Researcher, 2025.

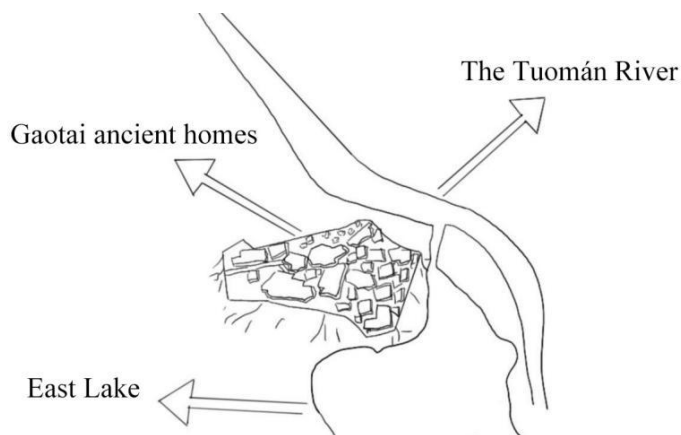


Figure 2 Site selection of the Gaotai ancient house settlement.

Source: Researcher, 2025.

Objectives

1. To examine the macro site-selection logic and settlement pattern of the Gaotai Residential Area in relation to terrain and urban context.

2. To analyze the spatial organization of the settlement from the perspectives of vertical stratification, neighborhood unit relations, and public-private transition.

3. To reveal the cultural logic and ecological adaptability embodied in the architectural space of the Gaotai Residential Area, and to provide references for conservation and regional design.

Literature Review

1. Previous research on traditional dwellings in Kashgar and related vernacular settlements has increasingly focused on environmental adaptation, enclosure systems, and spatial performance. Dai, Wang, Dewancker, and Gao (2023) examined the effects of building enclosure type and building orientation on indoor thermal comfort in traditional Kashgar courtyard dwellings, showing that enclosure configuration and orientation are closely related to environmental performance. In a broader Chinese vernacular context, Gou, Li, Zhao, Nik, and Scartezzini (2015) highlighted that traditional dwellings achieve climate responsiveness through compact settlement form, mutual shading, thermal mass, and locally adapted spatial organization. Together, these studies provide a stronger basis for understanding earthen construction, courtyard-based layouts, and climate-responsive design strategies in arid and high-contrast environments.

2. At the settlement level, recent studies suggest that the spatial logic of traditional residential areas should be read not only through individual building form but also through the relationship among alleys, semi-open spaces, and environmental mediation. Philokyrou, Michael, and Malaktou (2021) showed that semi-open spaces in vernacular architecture function simultaneously as climatic buffers and socio-cultural transitional zones. This perspective is useful for interpreting the spatial sequence of streets, porches, and courtyards in high-density residential fabrics such as Gaotai, where circulation, privacy, and

neighborhood interaction are strongly shaped by layered spatial transitions rather than by isolated architectural units alone.

3. More recent scholarship has also extended the discussion from architectural form to urban transformation, conservation, and the politics of spatial change. Liu and Yuan (2019), in their study of Kashgar's old-town redevelopment, argued that the reconstruction of historic space is closely tied to questions of security, governance, and the reorganization of everyday life. This suggests that research on Gaotai should move beyond descriptive morphology and examine how spatial structure, cultural logic, and ecological adaptation interact within a changing heritage context. Although studies on thermal comfort, vernacular environmental strategies, and urban restructuring have provided important insights, an integrated interpretation that links spatial form, cultural meaning, and ecological intelligence in the Gaotai Residential Area remains relatively limited. This is the gap addressed in the present study.

Methodology

This study adopts a qualitative architectural research approach combining field observation, image documentation, and literature review. The Gaotai Residential Area was treated as a representative case of traditional Uyghur settlement space in Kashgar. The analysis focuses on how the built environment responds to natural topography, climate, neighborhood interaction, and cultural practice.

The analytical framework is organized into four dimensions: (1) macro site selection and settlement layout; (2) vertical stratification and functional zoning; (3) neighborhood unit organization and public-private transition; and (4) material adaptation and structural technique. Through this framework, the study interprets both the physical configuration of space and the cultural meanings embedded in it.

In order to strengthen interpretability, the textual analysis is supplemented by photographs, settlement diagrams, and summary tables derived from the source manuscript. The resulting discussion is not intended as a quantitative survey, but as a structural reading of spatial characteristics and their underlying cultural logic.

Results

1. Macro site selection and settlement texture

The Gaotai Residential Area is located on a loess cliff more than 30 meters high at the northeastern end of Kashgar Old Town. This elevated setting historically reduced the risk of flooding from the Tuman River and provided a stable foundation for earth construction. Because the terrain is high in the south and low in the north, the settlement developed a stepped spatial order along the contour lines rather than through large-scale leveling.

At the urban scale, the internal street-alley system is closely linked to the overall morphology of the site. The east-west direction of the main passages, the limited number of external entrances, and the irregular form of intersections all reflect a gradual process of adaptation to movement patterns, courtyard entrances, and terrain conditions. This gives the settlement a compact yet legible fabric.

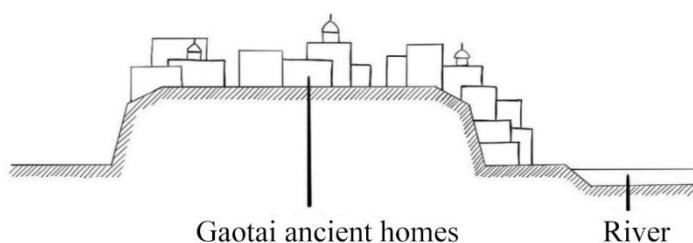


Figure 3 Spatial layout of the Gaotai ancient houses.

Source: Researcher, 2025.

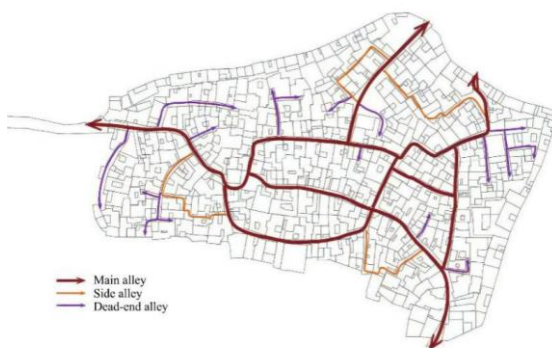


Figure 4 Street distribution in the Gaotai Residential Area.

Source: Researcher, 2025.

2. Building forms and public-private transition

The residential buildings follow the terrain and extend vertically and laterally in a flexible manner. Over time, several characteristic forms emerged, including overpass buildings spanning alleyways, half-built structures inserted into slopes, and suspended forms that enlarge upper-level living areas without blocking the narrow passages below. These building forms improve spatial efficiency and create a distinctive three-dimensional settlement image.

Neighborhood organization is structured around a sequence of public alleys, semi-public porches, and private courtyards. Narrow alleys with high walls provide circulation, climate protection, and informal social contact. Transitional spaces such as porches and under-eave corridors mediate between the outside and the household interior, while courtyards and prayer rooms form the core of private family life.

Building form	Spatial description	Functional significance
Overpass building	Upper rooms extend above a narrow alley while keeping the ground path open.	Improves land-use efficiency and provides shade in circulation space.
Half-built structure	Part of the dwelling is embedded into the slope and part projects outward.	Adapts to irregular topography and reduces earthwork.
Suspended building	Upper-level space is supported beyond the lower wall line or passage edge.	Expands usable living space under limited site conditions.

Table 1 Characteristic building forms in the Gaotai Residential Area.

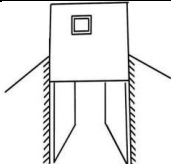
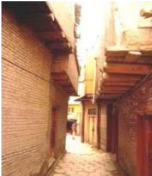
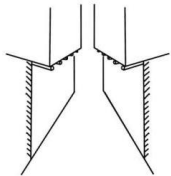
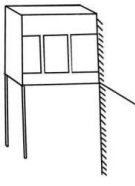
Building form	Picture	Simple diagram
Overpass building		
Half building		
Suspended building		

Table 2 Public, semi-public, and private spatial transitions.

Source: Researcher, 2025.

3. Vertical stratification and functional zoning

A notable characteristic of the Gaotai dwellings is their vertical division into a semi-basement ground level, a middle living level, and a roof level. The lower level is mainly used for storage, livestock, and utility functions; the middle level accommodates the Aywang, bedrooms, kitchens, and courtyard activities; and the roof level is used for drying, summer cooling, and other open-air functions.

This vertical organization is not based on formal symmetry, but on practical needs and the efficient use of restricted land. It demonstrates how residential space is layered in response to climate, family life, and terrain, thereby producing a compact yet highly functional dwelling system.

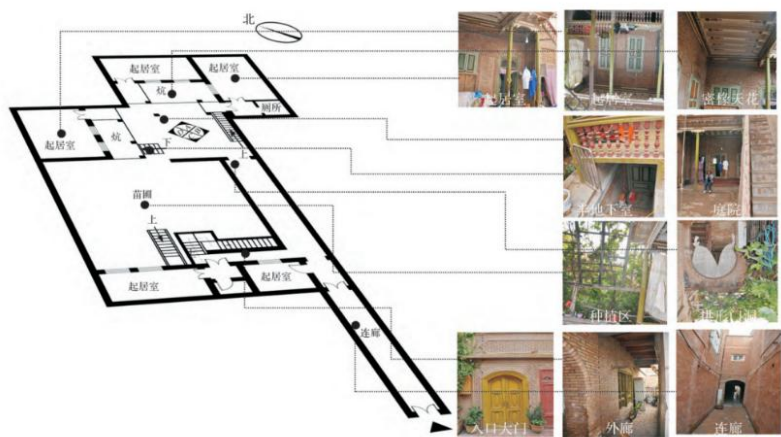


图1 老城吾斯塘博依街道7组12号院落与门窗布局示意图

Figure 5 Vertical space design of the Gaotai ancient house.

Source: Researcher, 2025.

4. Materials and structural adaptation

The material and structural system of the Gaotai Residential Area is centered on the principle of using local materials and adapting to climate. Adobe walls, timber support systems, and flat roofs form the core construction logic.

Thick earth walls provide thermal mass and improve indoor comfort, while local poplar and willow wood are used for beams, columns, and purlins.

Ventilation is enhanced through skylights and wall openings, forming a natural air-exchange system. In this way, the material system is not merely a technical choice; it is a regional strategy that integrates structural stability, thermal performance, economic practicality, and local construction knowledge.

Table 3 Summary of the material and structural system.

Material/element	Main application	Typical characteristic	Adaptive value
Raw soil / adobe	Wall construction	Thick earthen walls with good thermal mass	Heat insulation, local availability, lower cost
Poplar / willow wood	Beams, columns, purlins	Flexible timber roof-support system	Structural stability and easier repair
Brick and stone	Ground paving and selected base elements	High hardness and wear resistance	Durability and moisture resistance
Flat roof with straw and loess layers	Roof enclosure	Multi-layer local technique	Thermal protection and usable drying space

Discussion

The above results indicate that the spatial structure of the Gaotai Residential Area is not a random accumulation of houses, but a coherent response to a complex environmental and cultural context. At the settlement level, adaptation to topography determines the stepped distribution of residences; at the neighborhood level, the public-to-private sequence organizes circulation, interaction, and privacy; and at the building level, vertical layering and local materials support daily life under harsh climatic conditions.

From a cultural perspective, the courtyard-centered spatial order reflects the importance of family reunion, while the controlled transition from alleys to porches and then to private interiors expresses a strong concern for privacy and household boundaries. The arrangement of prayer rooms and the reserved internal spaces further demonstrates how religious belief is spatially embedded in the dwelling environment.

From an ecological perspective, narrow alleys, high walls, thick adobe envelopes, natural ventilation, and roof-level multifunctional spaces together form a localized strategy for thermal comfort, wind protection, and efficient land use. In this sense, Gaotai can be understood as a typical example of cultural-ecological symbiosis in traditional residential architecture.

Recommendation

First, the conservation of the Gaotai Residential Area should move beyond the protection of isolated buildings and instead focus on the preservation of the overall spatial structure, including street texture, courtyard relationships, and vertical spatial organization. Graded protection strategies can help distinguish between core historic fabric and areas suitable for adaptive renewal.

Second, traditional building knowledge and repair techniques should be documented and transmitted together with the material fabric. Local earth-building methods, timber roof construction, and climate-responsive spatial practices are integral to the value of the settlement and should be incorporated into conservation planning and community participation.

Third, future research and conservation practice may benefit from digital recording and management tools such as GIS, BIM, and three-dimensional documentation. These methods can support long-term monitoring, precise

restoration, and the interpretation of spatial change, while also helping balance heritage protection with contemporary living needs.

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