Architectural Form and Architectural Culture of Mountain Residential Dwellings in the Xinxiang Region, Henan, China

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Abstract: Mountain dwellings in the Xinxiang region, situated along the eastern foothills of the Taihang Mountains in northern Henan, developed as an adaptive construction system shaped by mountain terrain, locally available resources, and a historically layered cultural context. Based on literature review and textual examination, field investigation, high-precision measured survey, and measured drawings and redrafting, this study establishes an analytical framework covering dwelling overview, architectural form, and building structure. Two representative cases are examined in detail: Courtyard No. 1 in Longwoyan Village, characterized by stone–timber composite construction, and the Former Site of Chen Geng's Command Post in Pingdian Village, characterized by brick–timber composite construction and a front-shop, rear-residence arrangement. The analysis clarifies how courtyard configuration, orientation and enclosure strategies, and material selection correspond to topographic constraints and local stone and brick resources, and how key components, including lintels, gable walls, and rear eave-wall treatments, are associated with structural requirements and environmental adaptation. The study offers a case-based understanding of mountain dwellings in Xinxiang and supports conservation, transmission, and adaptive reuse planning in cultural-heritage practice.

Keywords: Mountain Residential Dwelling; Traditional Dwellings; Stone Masonry Architecture; Form Characteristics

1. Introduction

Northern Henan refers to the area of Henan Province located north of the Yellow River. It borders the Yellow River basin to the south, is adjacent to the Yanshan Mountains to the north, is backed by the Taihang Mountains to the west, and faces the Bohai Sea to the east (Figure 1). The Taihang Mountains have steep terrain and limited accessibility, yet they provide abundant resources, including minerals, medicinal materials, and timber. Shanxi merchants developed a mountain trade network connecting Shanxi and northern Henan by building plank roads, operating mule-and-horse inns, and establishing guild halls. As a cultural medium, mountain stone masonry architecture in this region articulates a locally specific architectural culture, from site-adaptive layout and spatial organization to context-responsive stoneworking techniques, and demonstrates strong regional specificity that is difficult to reproduce elsewhere [1].

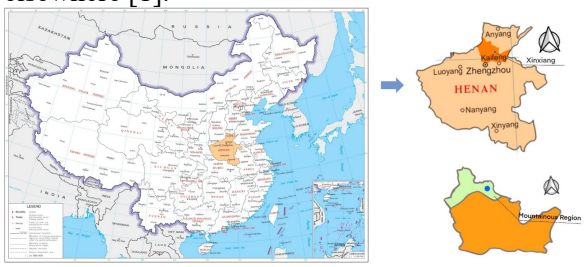


Figure 1. Geographic Location of Xinxiang Mountainous Region in China

Source: Adapted from Ministry of Natural Resources of the People's Republic of China, with modifications by the author.

2. Overview of Xinxiang Traditional Dwellings

Mountain residential dwellings in the Xinxiang region have a history spanning several millennia. They have attracted sustained attention from both researchers and local residents because of their context-responsive construction practices, the use of locally available materials, relatively unprocessed building methods, and the thermal advantages of indoor environments that remain warm in winter and cool in summer [2]. Centered on the eastern foothills of the Taihang

Mountains, mountain dwellings in Xinxiang exhibit a characteristic pattern of adapting to terrain and sourcing materials locally.

In villages such as Louzitou and Caomiao in Shibanyan Township, Linzhou, slates and stone blocks from the immediate area are used to construct pitched-roof dwellings. These settlements commonly form compound courtyard configurations that combine cliff kiln dwellings and courtyard compounds organized around a small internal court. Courtyards are arranged along contour lines, producing a vertical settlement structure described as mountain–field–dwelling–road–water [3]. In the mountain areas of Jiyuan and Xiuwu, by contrast, earth-based materials, including raw earth and rammed earth, are used to construct flat-roof dwellings or dwellings with gable tile roofs. The stone masonry kiln dwelling at Yidoushui Village in Xiuwu illustrates ecological adaptation through indoor environments that remain warm in winter and cool in summer [4].

2.1 Natural and Cultural Context

Owing to its geographical setting, the Taihang mountain area of Xinxiang exhibits a distinctive mountain microclimate. Ambient temperatures are relatively low throughout the year. Winters are comparatively cold, while summers remain cool. The mean summer temperature typically does not exceed 28 °C, making the area suitable for summer heat avoidance. Annual precipitation is approximately 650 mm, but rainfall is unevenly distributed, with a pronounced seasonal concentration. Most precipitation occurs in summer and autumn, often in the form of heavy rain or rainstorm events. In terms of wind regime, east-northeasterly winds prevail for much of the year. In winter, the southward expansion of the Siberian cold high-pressure system strengthens the dominance of northeasterly winds.

In physical terms, the Xinxiang region forms an interlaced zone between the piedmont alluvial plain and low hills along the eastern foothills of the Taihang Mountains. The terrain generally descends gently from northwest to southeast, while local areas exhibit pronounced undulations. This topographic condition provides relatively level building sites, but it is not an uninterrupted flat plain. Instead, micro-topographic variation influences village siting and spatial arrangement. More importantly, Xinxiang has high-quality granite and coal resources. This resource endowment directly supports a robust material system in local dwellings, which commonly employ bluestone for foundations, grey brick for wall construction, and grey tiles for roofing. As a result, the buildings present a sense of solidity and a defensive character that are closely associated with the local geological context.

In cultural and historical terms, Xinxiang lies on the Henan–Shanxi border, and the activities of Shanxi merchants facilitated the convergence of architectural styles. For example, vernacular dwellings in Bo'ai, Jiaozuo display decorative features associated with southeastern Shanxi, while dwellings in Anyang reflect planning principles and construction regulations characteristic of official-style architecture. These cases indicate cultural interaction between Shanxi and Henan. In addition, migration waves from the late Yuan to the early Ming period introduced stone masonry techniques and agrarian practices. Recurrent warfare further made mountainous areas a place of refuge, leading to mountain villages with strong concealment and enhanced defensive capacity. By contrast, many plains settlements were damaged during conflicts, and comparatively few traditional villages have been preserved in plain areas [5].

2.2 Basic Architectural Form

Mountain dwellings in the Xinxiang region are predominantly organized as single-courtyard compounds. Typical configurations include north-sited and south-facing sanheyuan (three-section) courtyards and erheyuan (two-section) courtyards, with a clearly defined central axis and a rigorous spatial sequence. During construction, these mountain dwellings emphasize the integration of architecture with the natural setting. Because the mountain area contains abundant natural stone resources, most dwellings are built with locally sourced materials.

Long-term building practice has involved selecting stones according to their physical properties and workability and assigning them to appropriate building components. For example, high-hardness stones with strong weathering resistance, such as bluestone and limestone, are commonly used for load-bearing masonry walls and building foundations. By contrast, slate with a pronounced bedding structure can be processed along its natural grain into thin pieces and used as stone tiles for roof covering [6].

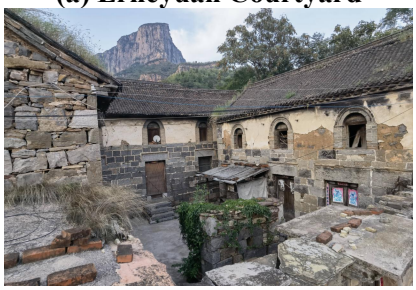
Constrained by mountain terrain and the stone–timber structural system, stone–timber houses in the Xinxiang region typically adopt rectangular plans. Both bay width and depth are limited. Bay width is usually 2–3 m, and plan depth is generally 3–5 m, resulting in a compact and shallow layout. The number of bays depends on available building ground, household economic conditions, and functional needs, with one-, two-, three-, and five-bay arrangements being common.

Except for one- and two-bay plans, which can be adjusted more flexibly, layouts with three bays or more generally follow a symmetrical arrangement centered on the central bay. Given the limited interior area, partitions are typically omitted, and bays remain visually and functionally continuous, creating an undivided interior with spatial continuity across bays.. Functionally, the central bay is mainly used for daily living activities, while the adjacent bays and end bays are used as bedrooms. This configuration enables relatively efficient space use and flexible functional assignment. Additional side rooms are seldom added to expand the floor area. Overall, this plan type features a straightforward structural logic, is easy to construct, and supports flexible use.

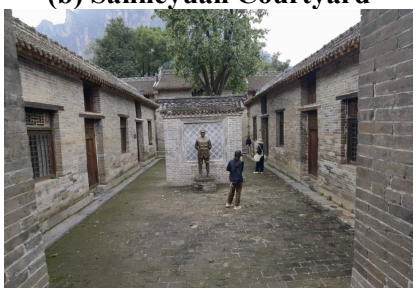
Courtyards in the mountain area of Xinxiang are predominantly organized as the sanheyuan courtyard form. Most follow a composition of one principal room and two wing rooms, enclosed by courtyard walls and a courtyard gate, thereby producing a strongly inward-oriented spatial enclosure. The frontage width of the three-section courtyard is typically 9–15 m, with a depth of approximately 12–20 m. The principal room most commonly comprises three bays. Constrained by mountain terrain, the two wing rooms are not necessarily arranged in strict bilateral symmetry.

The erheyuan courtyard form more often presents either a configuration of one principal room and one reversely-set room, or one principal room and one wing room. These compounds are likewise enclosed by courtyard walls. Courtyard width is approximately 8–12 m and length is about 12–20 m, resulting in a compact layout. Buildings commonly adopt two-bay or three-bay forms. The formation of these courtyard types is mainly associated with constraints in household economic conditions, as well as practical pressures such as insufficient homestead plot sizes and land scarcity driven by population growth within villages (Figure 2).

(a) Erheyuan Courtyard



(b) Sanheyuan Courtyard



(c) Siheyuan Courtyard

Figure 2. Examples of Mountain Buildings with Different Architectural Forms in Xinxiang

Source: Photograph by the author.

2.3 Architectural Art

Most mountain dwellings in the Xinxiang region are one-storey buildings capped with a loft. Access to the loft level is provided by a timber ladder with an inclination of approximately 60°. The loft is typically not used for daily habitation and is mainly used for storing grain and household goods. Its clear height varies with the size of the structural frame and is approximately 2 m.

Given the higher elevation of the mountain area, summers are not excessively hot, whereas winters are cold. Relatively thick walls provide a degree of thermal insulation. More critically, the loft level functions as an effective thermal buffer, reducing indoor heat loss in winter. The same buffer layer is also significant for limiting solar heat gain and improving summer thermal performance.

Another climatic factor is the high summer

rainfall and humidity in this region. Stone floors are prone to moisture return, which makes ground-floor spaces less suitable for storage. By contrast, the loft level offers improved moisture protection, enabling long-term storage of grain and other items. The loft typically includes a single window composed of either four or two window lattice leaves, primarily to support indoor air circulation and to provide daylighting for the loft space [7].

Most mountain dwellings in the Xinxiang region adopt the flush gable roof form. Across the courtyard compound, natural stone is used from wall surfaces to the primary building fabric, while the roof is accented with grey brick. In terms of colour and material texture, the architecture integrates closely with its surrounding setting. With limited applied carving, the material palette remains visually consistent with the surrounding setting, and the buildings exhibit a clearly articulated character [8].

3. Architectural Form Analysis of Mountain Dwellings in the Xinxiang Region

Mountain dwellings in the Xinxiang region exhibit considerable variation in spatial form. This diversity is primarily generated by the dynamic relationships created through the combination of different building volumes. To examine this characteristic in depth, the study integrates literature review and textual verification, field investigation, high-precision measured survey, and measured drawings and redrafting. On this basis, two representative types of mountain dwellings were selected for case-based analysis and discussion.

3.1 Stone–Timber Composite Construction: Courtyard No. 1, Longwoyan Village

This courtyard compound is located in Longwoyan Village, Shibaotou Township, Weihui City, Henan Province, and is among the better-preserved examples of traditional dwellings in the village. The compound adopts an L-shaped arrangement. The principal room is located on the north side and faces south, and the entrance is opened on the east side of the enclosure wall. The enclosure wall is approximately 6 m high. Both the principal room and the wing room are single-storey buildings capped with a loft. The walls are built with locally sourced bluestone blocks. The compound is composed of the north-side principal room and the west-side wing room. Overall, the courtyard measures about 15 m in the north–south direction and 22 m in the east–west direction, forming a rectangular footprint (Figure 3).

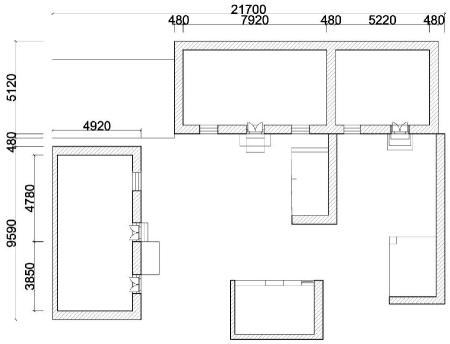


Figure 3. Plan of Courtyard No. 1 in Longwoyan Village, Weihui City

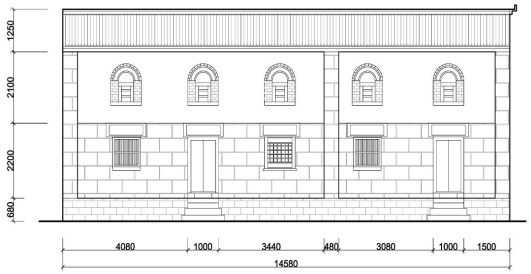
Source: Photograph and drawing by the author.

In traditional dwellings, variations in rear eave-wall treatment are reflected in whether the eave rafters and flying rafters project beyond the wall line. In this courtyard, the rear eave wall is of the enclosed-wall type, where the masonry rises upward to meet the eaves line of the rear roof slope. The rear eave rafters are seated on the rear eave purlin and do not cantilever outward.

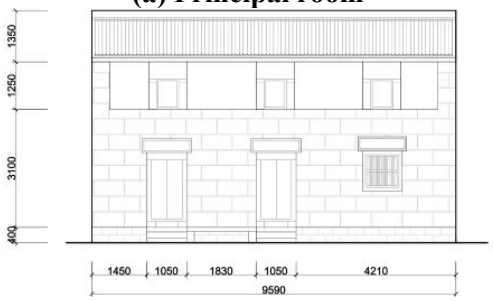
The primary eaves detail in this courtyard is the diamond-corner eave, which is formed with only three corbelled layers. After the first layer is corbelled out from the wall face, the second layer adopts diagonal masonry with exposed corners, in which stretcher bricks are rotated by 45° to form projecting corners that expose isosceles triangular faces. In the third layer, grey bricks are in some cases laid in a header bond.

The principal room adopts a five-bay layout with a wujian-ersuo plan (five-bay, two-unit). Bay widths vary slightly, ranging from 2.5–2.7 m, and the overall depth is 4.17 m. The walls are built in bluestone masonry, and the exterior wall face is finished with a loess and lime plaster. The roof is a pitched roof covered with grey tiles. The edges of door and window openings are lined with grey brick to form regular rectangular outer frames. The primary structure is well preserved, and no windows are opened in the gable walls (Figure 4a).

The wing room adopts a three-bay layout and takes a three-bay, two-unit plan form. Bay widths vary slightly, ranging from 2.5–2.7 m, and the overall depth is 4.17 m. At the loft level, the lintel is formed with strip stone, which differs from the semicircular arched lintel used in the principal room, and the detailing is correspondingly simplified (Figure 4b).



(a) Principal room



(b) Wing room

Figure 4. Elevation drawings of Courtyard No. 1 in Longwoyan Village, Weihui City

Source: Drawing by the author.

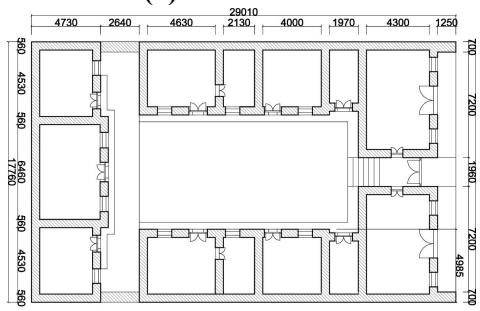
The roofs of traditional dwellings in Longwoyan Village are restrained in both colour and form. In terms of roofing material, local dwellings commonly use small grey tiles. The roof is predominantly executed as a gancha tile roof, in which only pan tiles are laid without cover tiles, thereby reducing material consumption while requiring higher workmanship. The main ridge adopts a three-brick, three-tile ridge-capping detail. For the vertical ridges at the gable ends, the pishui-shaolong detail is the most commonly used treatment.

3.2 Brick–Timber Composite Construction: Former Site of Chen Geng's Command Post

The former site of Chen Geng's Command Post is located in Pingdian Village, Bobi Town, Huixian City, Xinxiang, Henan Province. In March 2023, the village was included in the sixth batch of the Chinese Traditional Villages list. The village retains cultural heritage such as the Baixing Ancient Route and the former site of the Zhaoxingyi piaohao (draft bank), and it also contains revolutionary heritage sites, including the rear-area hospital of the 129th Division of the Eighth Route Army and the former command headquarters associated with General Chen Geng. Influenced by the commercial function of the ancient route, a large number of shop–dwelling buildings are still preserved along both sides of the village's main street. The prevailing dwelling form is brick–timber composite construction, commonly organized in a front-shop, rear-residence arrangement. In some more commercially developed settlements, the reversely-set room of a courtyard may also be used as a shop or a handicraft workshop, becoming part of local economic activity.

The courtyard discussed here is located in Pingdian Village and is among the better-preserved examples of a traditional front-shop, rear-residence dwelling in the village. The compound is a single-courtyard courtyard house. Because the village's main street runs north–south and the compound is situated on its west side, the courtyard is oriented to face east. The gate opens on the street-facing east side. The enclosure wall is approximately 7 m high. The principal room is a single-storey building capped with a loft. The walls are built with bluestone bricks and blocks. The compound consists of the west-side principal room, the south- and north-side wing rooms, and a street-front shop that occupies the reversely-set room (Figure 5).

(a) Aerial View



(b) Floor Plan

Figure 5. Aerial View and Plan of the Former Site of Chen Geng's Command Post

Source: Photograph and drawing by the author.

The reversely-set room has a total frontage of seven bays. The entrance gate divides the reversely-set room into three bays on each side. The principal room functions as the main gate leading into the courtyard house and serves as the primary passage opening. The principal room has a three-bay frontage, with a side room on each side. It is built in grey brick masonry with a pitched roof covered in grey tiles. Door and

window openings are spanned by timber lintels, and their outer edges are formed as regular rectangular frames. The foundation level of the principal room is slightly raised relative to the south and north wing rooms, and its overall height is the greatest among the buildings in the compound (Figure 6).

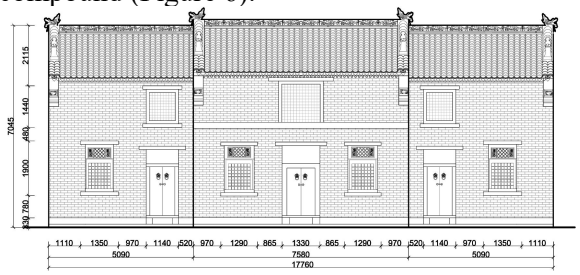


Figure 6. Elevation Drawing of the Principal Room at the Former Site of Chen Geng's Command Post

Source: drawing by the author.

The south and north wing rooms adopt a five-bay, two-unit layout with an additional side room. They are built in grey brick masonry with pitched roofs covered with grey tiles. Door and window lintels are all timber lintels. The overall height is approximately 5.4 m, which is lower than that of the principal room. In the connecting courtyard walls between the principal room and the wing rooms, a small door is opened on each side to link directly to the street outside. The window lattice of the wing rooms adopts a common grid pattern (Figure 7).

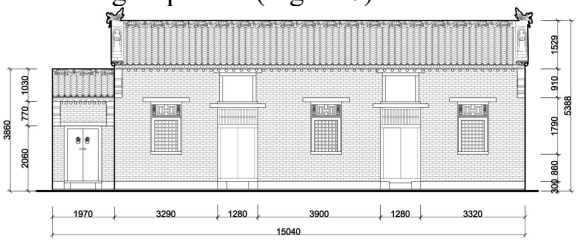


Figure 7. Elevation Drawing of the Wing Room at the Former Site of Chen Geng's Command Post

Source: drawing by the author.

In front of the reversely-set room, six stone columns are arranged along the façade. Shallow relief carving is applied to the column bases, combining cloud-and-water motifs, plant motifs, and geometric patterns. Other components, including the larger architraves, bracket sets, and sparrow braces, are executed in timber. The sparrow braces had been lost and have now been reinstalled as part of restoration work.

The main door plaque bears the inscription Zhaoxingyihao, which is the name of this draft bank. Street-front shop spaces to the left and right of the entrance appear to have received different types of merchants. The right-side plaque reads Dadao Laoshiye, which likely designated a room for long-standing clients. The inscription on the left-side plaque is severely damaged and cannot be identified (Figure 8).

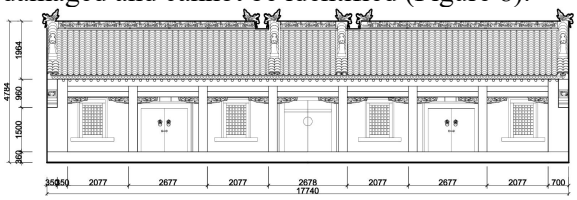


Figure 8. Elevation Drawing of the Reversely-Set Room at the Former Site of Chen Geng's Command Post

Source: Drawing by the author.

4. Building Construction and Components

In the Xinxiang region, traditional dwellings predominantly adopt the flush gable roof form. Elevations are commonly articulated into two zones, namely a roof zone and a wall zone. The roof zone comprises the roof ridge, roof slopes, and the eaves. On the eave-wall elevation, the wall zone is composed of plinth stones, walling, door and window openings, a projecting porch, and the eaves overhang.

(1) Gate. The gate includes a lintel beam with decorative plaque inscriptions, which carry layered meanings. In traditional dwellings in the Xinxiang region, plaque inscriptions on gates cover diverse themes. Some symbolize happiness and aspirations for a better future, while others record inherited family precepts.

In Xinxiang, door leaves of the principal room are primarily decorated with wood carving. Typical motifs include vases, auspicious clouds, and peony flowers, as well as continuous square-pattern compositions such as shuangjiao siwan (double-interlaced four-unit) pattern, cross ruyi, and related variants [9]. The shuangjiao siwan diamond-pattern lattice is formed by the intersection of two lattice members and is associated with ideas of growth and social well-being [10]. A higher-grade pattern, the sanjiao liuwan diamond-pattern lattice, is formed by the junction of three lattice members, with the intersections fixed to form a central rosette. It is associated with orthodox cosmological order and the generation of all things through the interaction of Heaven and Earth, and is regarded as a highest-grade decorative pattern for door and window lattice cores in Qing palace architecture (Figure 9).

(a) Vases Motif **(b) Shuangjiao Siwan Motif**

Figure 9. Door Decoration in Mountain Dwellings in the Xinxiang Region

Source: Photograph by the author.

(2) Chitou (projecting gable-end wall). Chitou is primarily built in combined brick-and-stone masonry. The brick-carved chitou adopts a restrained linear treatment, with motifs including auspicious clouds, geometric patterns, and a galloping-horse motif. The pantou is not elaborately carved. Instead, it is formed by stacking the original bricks to create a corbelled profile [11].

In commercially developed mountain areas of Xinxiang, galloping-horse motifs of varying forms are carved on the qianyan at both sides of the chitou, and are surrounded by geometricized patterns. These forms and motifs indicate the prosperity of commercial routes. Compared with the chitou in other mountain areas of Xinxiang, which are characterized by a more bold, plain, and rough expression, Pingdian Village shows finer workmanship under the influence of plain-area cultural elements introduced through the movement of Shanxi merchants, and its carving techniques are relatively more refined (Figure 10).

(a) Auspicious Clouds **(b) A Galloping-Horse Motif**

Figure 10. Projecting Gable-End Wall in Mountain Dwellings in the Xinxiang Region

Source: Photograph by the author.

(3) Lintel. In the load-bearing stone-masonry wall system of mountain areas in Xinxiang, a lintel is placed above door and window openings. This is a key construction element for carrying the load above the opening and maintaining the integrity of the wall structure. As an independent flexural member, the lintel helps to redistribute stresses and reduces the risk of cracking or damage in the surrounding masonry caused by concentrated loading.

Lintel types above door openings show a contrast between the plains and mountain areas of Xinxiang. Timber lintels are more common in the plains, whereas stone lintels are more prevalent in the Taihang mountain area of Xinxiang, where stone resources are abundant. Local economic conditions can also influence this choice. For example, Pingdian Village benefited from trade along the Shanxi–Henan commercial routes, and the movement of merchants introduced decorative traditions of vernacular dwellings from both Xinxiang and Shanxi. Accordingly, lintels and architectural decoration in this courtyard are timber (Figure 11).

(a) Stone Lintels **(b) Timber Lintels**

Figure 11. Lintels in Mountain Dwellings in the Xinxiang Region

Source: Photograph by the author.

(4) Eaves of the enclosed wall. In traditional buildings in Xinxiang, variations in the treatment of the rear eave wall are primarily determined by how the eave construction is handled. This is specifically expressed by whether the eave rafters and flying rafters project outward. Accordingly, two basic types can be identified: an exposed-eaves type with projecting rafters and an enclosed-wall type. In the mountain area of Xinxiang, common eaves details mainly include the lingjiao (diamond-corner) eave and the chouti (drawer-like) eave [12].

(5) Gable wall. In mountain dwellings in Xinxiang, the gable walls serve as enclosure elements on both sides of the building and constitute the primary image of the side elevations. They typically perform a load-bearing role and directly support the purlin

system. As a result, the elevation treatment is relatively restrained, often expressed as large areas of solid wall, with only occasional small windows or circular window openings as accents.

5. Conclusions

Drawing on both the geographical environment and the humanistic–historical context of the Xinxiang region, this study presents a systematic discussion of the artistic characteristics and construction system of mountain dwellings in Xinxiang. Two representative cases were selected as core materials for analysis: Courtyard No. 1 in Longwoyan Village, characterized by stone–timber composite construction, and the Former Site of Chen Geng's Command Post, characterized by brick–timber composite construction. Through these cases, the study examines and clarifies the courtyard architectural form, structural logic, and decorative art of local dwellings.

Mountain dwellings in Xinxiang constitute an adaptive system formed under distinctive natural and humanistic conditions. In Longwoyan Village, the stone-masonry two-section courtyard exhibits a regular composition of one principal room and one wing room, heavy bluestone walls, a restrained gancha tile roof, and an enclosed-wall treatment with a lingjiao (diamond-corner) eave detail. Together, these features summarize the construction strategies of using locally available materials and responding to local conditions in deep mountain settings, as well as an aesthetic orientation that is reserved and restrained.

By contrast, the brick–timber courtyard house with a front-shop, rear-residence arrangement at the Former Site of Chen Geng's Command Post in Pingdian Village reflects the historical function of an ancient-route commercial node. Its street-front reversely-set room incorporates eave columns and carved column bases. The decoration is comparatively refined, indicating cultural interaction introduced through Shanxi–Henan trade routes and a relatively higher local economic level.

Analysis of mountain dwellings in Xinxiang further suggests that, from overall configuration to decorative detail, these buildings embody a pronounced regional logic and a layered historical–cultural content. They function not only as physical shelters but also as material condensations of regional ecology, social organization, and vernacular knowledge. This distinctive construction system warrants careful conservation, transmission, and adaptive reuse within cultural-heritage practice.

Acknowledgments

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