Case-Based Typological Analysis of Traditional Dwellings in the Lower Shandong Reaches of the Yellow River Basin

Kangsen Bai[1], Liyue Wu[1, 2], Yanjun Li[1,*]
[1]School of Design & Art, Shaanxi University of Science and Technology, Xi'an, Shaanxi, China
[2]Xi'an Zhongda Shiye Co., Ltd., Xi'an, Shaanxi, China
**Corresponding Author*

Abstract: This study conducts a case-based typological analysis of traditional dwellings in Zibo, Binzhou, and Dongying in the lower reaches of the Yellow River in Shandong. Using literature review, field investigation, on-site measurement, and drawing, it compares four types: lineage-based clustered dwellings, defensive-facility compounds, merchant residential compounds, and official-and-gentry residences. The analysis addresses plan layout, settlement siting, and decorative style. Results indicate that spatial organization aligns with dominant social functions and symbolic order, from compact co-residential courtyard compounds to defense-oriented enclosures, street-facing shop–residence hybrids, and hierarchy-driven official residences. The findings support documentation and conservation of remaining vernacular heritage.

Keywords: Lower Reaches of the Yellow River; Traditional Dwellings; Typological Analysis; Functional Layout

1. Introduction

In traditional dwellings in the lower reaches of the Yellow River, although most take sanheyuan and siheyuan as their basic architectural forms, fundamental differences exist in plan organization and spatial functions because their construction responded to different social functions and practical needs. Under the influence of Confucian ritual culture rooted in the Shandong region, hierarchical order and ethical norms are particularly prominent in the built environment. Meanwhile, settlement types such as the defensive-facility type, the merchant residential compound type, and the official-and-gentry residence type may resemble the lineage-based clustered type in architectural form, yet they differ markedly in spatial layout and functional orientation. This contrast reflects the diverse strategies adopted by different social groups to adapt to the environment, organize everyday life, and represent social identity.

In the context of rural revitalization, related studies in central Shandong propose renewal principles and strategy frameworks that emphasize authenticity of the built character, regional continuity, environmental adaptability, and cultural transmission, providing a relevant reference for conservation-oriented discussion in this paper. [1]

2. Overview of Traditional Dwellings in the Lower Reaches of the Yellow River in Shandong

As an important part of the Yellow River alluvial plain in northwestern Shandong, Binzhou and Dongying exhibit pronounced regional adaptability and ecological wisdom in their traditional dwellings. Located near the Yellow River estuary, the terrain is low and flat and the soil is saline-alkaline. Historically, the area was vulnerable to Yellow River floods. Accordingly, courtyard layouts and construction methods place particular emphasis on flood mitigation and structural stability. Courtyard-based forms are prevalent, and villages were often affected by floods and wildlife disturbance. As a result, both dwellings and settlement systems prioritize strengthened safety protection. Walls are generally thickened and platforms are raised, and some villages were surrounded by earthen flood-control embankments or drainage ditches. [2][3] Building materials make full use of local resources. Walls are often rammed with saline-alkaline soil mixed with wheat straw to increase toughness, and roofs commonly use bundled reeds covered with saline-alkaline soil. This "alkaline-soil and reed" system provides thermal insulation, remains economical and durable, and effectively adapts to humid and hot summers, cold winters, and saline-alkaline soils. Influenced by historical migration-driven

reclamation and salt-production activities, village layouts are often loosely grid-like, with larger spacing between courtyards. Alleys accommodate both production and circulation needs. Overall, dwellings in Binzhou and Dongying are characterized by pragmatic responses to nature and plain use of local geography, providing a clear residential expression of human–land relations in the Yellow River Delta.

Through long-term building practice, traditional dwellings in Zibo developed diversified forms that closely match local natural conditions and resource endowments. Structurally, two typical approaches are evident. One is a paishan-style timber frame, in which timber beams and columns support roof loads. This traditional timber system is widely used. The other is a load-bearing wall system, in which inner and outer brick walls directly carry the roof weight. Walls commonly use a brick or stone base with earthen bricks above. Exterior walls are often smoothed with yellow-mud plaster and finished with a lime wash. Roofs typically use timber roof frames with tiles, or adopt a locally characteristic haiqing method that combines thatch and tiles, which is economical and practical. Regional differences are especially clear. In the southern mountainous area, dwellings follow undulating terrain and are flexibly arranged on slopes, forming terraced sanheyuan courtyards. [3] Construction widely uses local stone. Walls are often built using gancha masonry or stone-to-top masonry, combined with solid-timber doors and windows, producing a plain and robust mountain character. Overall, Zibo dwellings integrate timber framing with brick-and-stone load-bearing systems. Their material selection, construction techniques, and formal organization reflect a building logic of adapting measures to local conditions and making effective use of available materials, and they vividly indicate the diversity of dwelling culture across a transitional landscape from plains to mountains [2].

Existing scholarship summarizes Shandong vernacular dwellings at the provincial scale, highlighting regional variation in materials, construction, and architectural form, alongside the prevalence of courtyard compounds and axial ordering. [4] Building on this context, this study focuses on courtyard compounds in the lower reaches of the Yellow River in Shandong and examines how social functions drive spatial differentiation across representative cases.

3. Case-Based Analysis of Traditional Dwelling Types in the Lower Reaches of the Yellow River in Shandong

Because traditional dwellings emphasize different practical functions in construction and use, they have developed distinct dwelling types. Based on a combined approach of archival data collection, field investigation, on-site measured survey, and drawing production, this paper selects representative cases for systematic analysis and comparative argumentation.

3.1 Lineage-based Dwelling: Zhao Family Architectural Complex

The Zhao Family Architectural Complex is located in Yujia Alley, Shangyoujing Village, upstream of Wuyang Lake in Shima Town, Zibo. It is a relatively large surviving Qing-dynasty residential complex with an intact layout. The main buildings were constructed in the seventh year of the Guangxu reign of the Qing dynasty (1881). The complex faces north, adopts a brick–timber hybrid structure, and has a total floor area of approximately 266.3 m². It is a representative example of lineage-based clustered dwellings. [5] The complex comprises two successive siheyuan courtyards, organized as a principal eastern yard for daily living and ritual activities and an auxiliary western yard for service spaces. A central passage hall links the two courtyards, where a screen wall marks the entrance axis; the principal room is connected to a two-story side room, introducing a vertical linkage within the domestic compound (Figure 1).

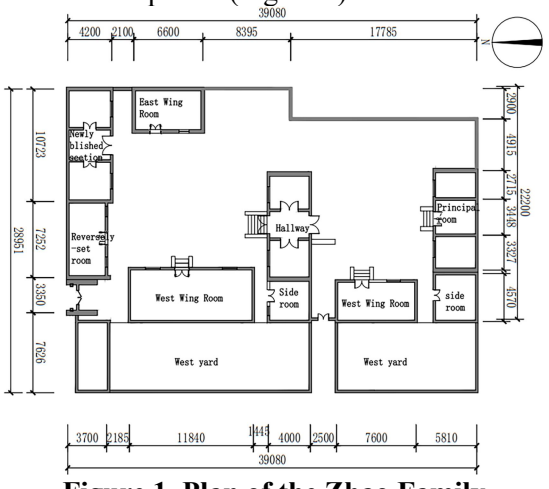
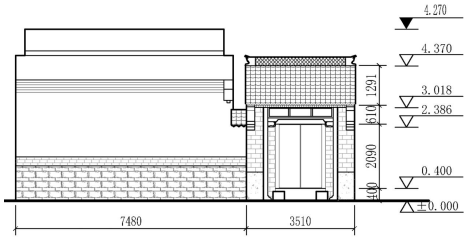


Figure 1. Plan of the Zhao Family Architectural Complex (Source: Drawn by the Author)

Overall, the complex follows a traditional

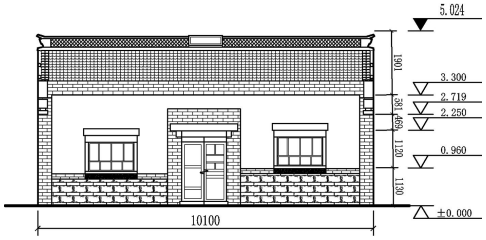
siheyuan layout and typically adopts a gabbled roof as its characteristic style. Its timber load-bearing system is stable and reliable. Although the daozuo building on the east side of the main courtyard has been renovated and parts of the roof have been replaced with red tiles, most buildings still largely retain their original appearance from the initial construction period. The door frames are built with grey bricks in a square profile, with a robust form and careful workmanship. Their overall proportions are appropriate, presenting the plain and solid character of northern Chinese vernacular dwellings. The Zhao Family Architectural Complex not only conveys a strong sense of everyday life, but also provides a clear expression of local architectural form and craft characteristics, and it carries substantial historical and architectural-artistic value as well as significance as a repository of collective memory.

In the first courtyard, the reversely-set rooms and the east–west wing rooms define a clear primary–secondary order. The west-side reversely-set rooms measure 7 m in frontage width and 3.2 m in depth, while the east wing room measures 6.25 m by 3.7 m and the west wing room measures 11.3 m by 4.8 m. The passage hall, as the main transitional space between the outer and inner zones, measures 9.6 m in frontage width and 3.75 m in depth. Openings and door assemblies are designed to balance ventilation and privacy, and an attached lofted ancillary volume further enriches the courtyard section (Figure 2).



(a) Exterior Elevation of the Main Gate

(b) South Elevation of the Passage Hall



(c) North Elevation of the Passage Hall

(d) Elevation of the Principal Room

Figure 2. Elevations of the Zhao Family Architectural Complex
(Source: Drawn by the author)

On the west side of the second courtyard, a side gate is opened. A small screen wall is placed near the entrance, functioning as a spatial transition and a visual barrier, and also indicating the emphasis on entrance ritual order in traditional dwellings. The west wing room is of brick-and-stone construction. Its roof adopts a haiqing-style double-slope roof with thatch, and three steps are built in front, with a total height of approximately 0.63 m. The entrance is fitted with double-leaf wooden plank doors. This wing room has a frontage width of 7.6 m and a depth of 3.6 m. It contains two bays and presents a compact scale and a solid form.

The principal room on the south side is raised by five steps. It has a frontage width of 9 m and a depth of 4 m, and it is closely connected to the side room on the west side. The spatial treatment of this building group is distinctive. From the west side of the principal room, direct access is provided to the second floor of the side room, creating a vertically connected auxiliary space. Two high-level windows are opened on the second floor. They improve loft daylighting and enrich the façade through variations of solid and void. This linkage reflects vernacular builders' pursuit of functional integration and efficient spatial use on limited sites.

3.2 Defensive Dwelling: Wang Family Courtyard

The Wang Family Courtyard is located in Zhangli Village, Kunlun Town, Zichuan District, Zibo, Shandong Province, approximately 8.6 km northwest of the town government. The village is structured by intersecting north–south and

east–west main streets, and its western north–south street historically functioned as an official route linking Zhoucun and Boshan, known locally as an "ancient commercial avenue." Zhangli Village was listed as a provincial-level traditional village and as a China Traditional Village (fourth batch, 2016). [5]

The Wang Family Courtyard was first built in the early years of the Guangxu reign of the Qing dynasty and was subsequently expanded in several phases. The complex faces east and is divided into northern and southern sections by an east–west passage. It covers a total site area of 3,535 m². Historically, it included more than ten courtyards and two gardens, as well as auxiliary facilities such as gun emplacements, underground passages, a stele forest, stone carvings, and tethering posts. With comprehensive functions and a large scale, it was regarded as a model of Qing-dynasty northern siheyuan residential architecture. Courtyards were connected by side doors. The principal courtyard was located in the northeast, with a corridor-like front veranda. Wing rooms were arranged on both sides. The roof ridges were fitted with chiwen ornaments, and the brick carvings under the eaves show fine workmanship and delicate decoration.

Courtyards on the west side were built across the street and connected to the principal courtyard by a timber over-street passage hall. Its form resembles a southern covered bridge. Historically, it served as a viewing space for women of the household. A stage was originally built on the south side of the over-street passage hall, where opera troupes were invited to perform during annual festivals and ceremonial occasions, creating a distinctive space that integrated circulation and entertainment. At the four corners of the compound, bluestone-built gun towers were constructed. Three sides of each tower were opened with firing apertures for guns or firearms, enabling control of key street and alley approaches. A concealed underground passage was also built within the compound. Its exits led respectively to farmland outside the village and to a village well, serving both refuge and transfer functions and indicating the systematic and practical nature of settlement defense.

Although much of the compound has been lost over the past century, the surviving fabric is concentrated on the north side and remains relatively legible. Based on the remaining foundations, components, and decorative fragments, the former scale and spatial hierarchy can still be inferred (Figure 3).

Figure 3. Aerial View of the Courtyard (Source: Photographed by the author)

Five courtyards survive on the north side of the Wang Family Courtyard, including a siheyuan-type northern courtyard enclosed by juanpeng-roofed and gabbled-roof buildings in mixed stone-and-brick masonry. A defensive structure incorporating a watchtower is placed at the northwest corner, and arched openings are used for the main gate and windows. Carved details preserved along gables and eaves indicate late Qing decorative workmanship and suggest the former prosperity of the household (Figure 4).

Figure 4. Current Status of the Courtyard (Source: photographed by the author)

The west side of the Wang Family Courtyard comprises a two-courtyard compound. Entering from the south gate, three bays of reversely-set rooms are arranged to the left and right, all with gabbled roofs. The two bays on the west side have a frontage width of 13.4 m and a depth of 3.8 m. The single bay on the east side was originally used as a guard room. It has a frontage width of 9.7 m and the same depth of 3.8 m. The interior ceiling is built in brick as an arched, dome-like vault. A doorway is opened on its east side. On the north elevation, one door and two windows are provided, all in arched forms, and the functional layout remains clearly legible. At the pillar head of each building, simple geometric stone carvings are applied, with

regular patterns and crisp lines, indicating a building approach that integrates practicality with restrained ornamentation in traditional dwellings.

After passing through the main gate, a screen wall is embedded in the gable of the east wing room, and an east–west path links the three courtyard groups into a connected spatial sequence. The west courtyard is marked by a floral-pendant gate with an upturned-eave roof, where ridge-and-eave tile ornament and bracket detailing concentrate conventional auspicious motifs in a restrained manner (Figure 5).

In the first courtyard, the east and west wing rooms use juanpeng roofs and form the primary enclosure. The west wing room measures 8.5 m by 4.0 m and the east wing room measures 9.3 m by 3.6 m, while the passage hall on the north side measures 8.7 m by 3.87 m and serves as the principal transitional space. A west side room spanning the first and second courtyards measures 6.8 m by 3.7 m and connects structurally with the passage hall roof, indicating integrated spatial organization (Figure 6).

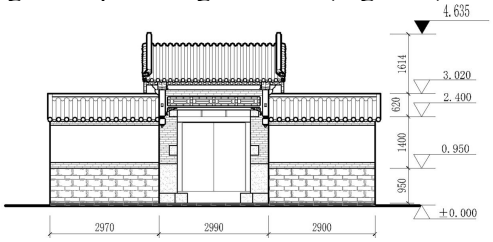
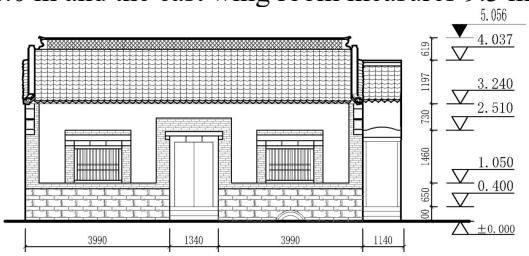
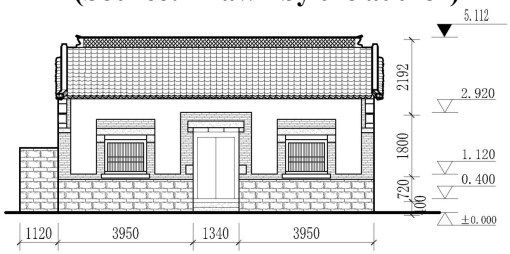


Figure 5. Floral-pendant Gate of the West Courtyard
(Source: Drawn by the author)

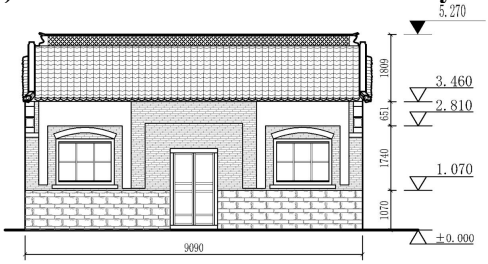


(a) East Elevation of the First Courtyard



(b) West Elevation of the First Courtyard

(c) South Elevation of the First Courtyard



(d) North Elevation of the First Courtyard

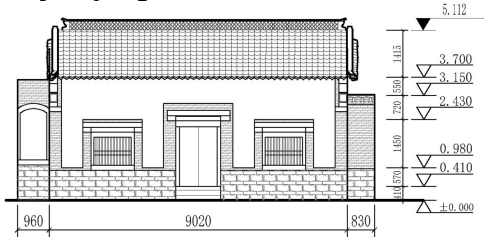
Figure 6. Elevations of the First Courtyard and Side Courtyard
(Source: Drawn by the author)

In the second courtyard, both the east and west wing rooms have juanpeng roofs and form a symmetrical arrangement, each with a frontage width of 9 m and a depth of 3.7 m. Each façade includes one door and two windows. The door lintel and window lintels are reinforced with stone strips, and two stone steps are provided at each entrance. A kang heated-bed system is installed in the west wing room. On its south side, it is adjacent to the window of the first-courtyard side room, while a passage is reserved on its north side. A passage is also provided on the south side of the east wing room to connect the middle courtyard, indicating the organic spatial linkage typical of courtyard-based architecture. [6] Small rear windows are opened in both wing rooms to enhance interior ventilation.

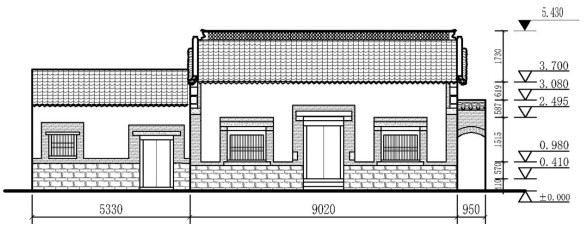
A cross-shaped brick-paved path organizes the central open space of the courtyard, and a stone mill is placed as a focal element that supports both circulation and daily use. According to local residents, an underground passage is concealed near the principal room and is said to lead outside the village. It reportedly served as a key facility for resisting bandit threats and for emergency escape by the Wang family. The principal room is a two-story loft building with a frontage width of 8.7 m and a depth of 3.8 m. The first floor is 3.9 m high and the second floor is 2.9 m high, with two stone steps at the entrance. An eave-level transition is formed between the first and second floors, and three arched windows are opened on the second floor. The interior ceiling is covered with wooden boards. On the west gable wall, a wooden ladder

provides access to the second floor, where the beam-and-rafter structure remains clearly visible. A small door is further opened on the west wall of the second floor, with a wooden ladder below that provides access to the roof of the west side room. The west side room is a stone-built defensive tower. Two stone steps are set in front of its entrance, and it is internally connected to the principal room. Its roof is constructed in brick as an arched, vault-like form. The door of the east side room opens to the west, and a passage 0.82 m wide is reserved in front.

Both the middle courtyard and the east courtyard maintain a basic sanheyuan layout. Although some buildings have collapsed and the area has become overgrown, the primary form remains identifiable. The middle courtyard was built adjacent to the east wing room of the first courtyard in the west courtyard. This wing room has a juanpeng roof and arched window openings, with a high-level window above to improve daylighting and ventilation. A side room is appended on the west side of the principal room. Differences in roof form and material indicate that the courtyard underwent repairs in different periods. The ground surface has been hardened and was once used as a village clinic. Carved stone ornaments can still be observed at the pillar heads and gable walls, suggesting traces of its former appearance. The east courtyard has suffered more severe damage, with many buildings collapsed. Only the principal room is relatively well preserved and is still occupied by villagers. On the east side of the courtyard, an eastern main gate remains. Directly opposite it, there is a remnant of a defensive tower, indicating the original defensive system and spatial order of the courtyard group (Figure 7).

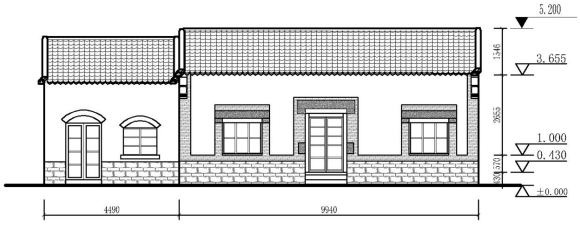


(a) East Elevation of the Second Courtyard

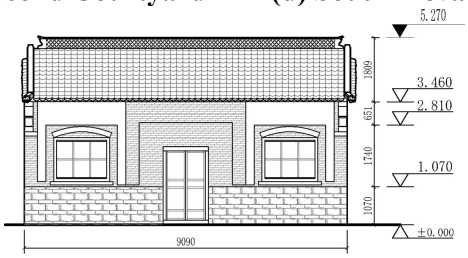


(b) West Elevation of the Second Courtyard

(c) South Elevation of the Second Courtyard



(d) South Elevation of the Side Courtyard



(e) East Elevation of the Side Courtyard

Figure 7. Elevations of the Second Courtyard and Side Courtyard (Source: Drawn by the author)

3.3 Merchant Residential Compound: Quanshun Courtyard

Quanshun Courtyard is located in Zhai Village, Le'an Subdistrict, Guangrao County, Dongying. Built around the twentieth year of the Daoguang reign (ca. 1840), it served as the residence associated with the Quanshuntang distillery funded by Li Luoshu.

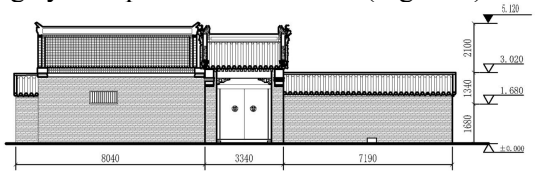
It was funded by the local wealthy resident Li Luoshu as a residence for the Quanshuntang distillery. The buildings are primarily constructed of grey bricks, grey tiles, and timber, with thick and solid walls. As the only surviving example of a Qing-dynasty dwelling in the Dongying area, Quanshun Courtyard has

important value for architectural and local history. Although only part of the complex remains, it still reflects the formal characteristics and construction techniques of merchant residential compounds in northern Shandong during the Qing dynasty.

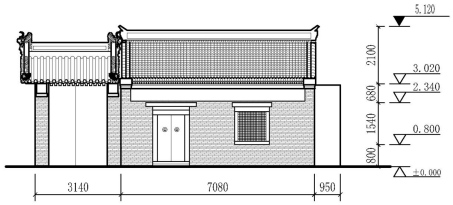
The Quanshun Courtyard complex functioned as a multifunctional commercial–residential compound integrating habitation, production, storage, and defense. Its original scale was substantial, with a total of 142 rooms including various buildings, open sheds, and stables. At present, the complex survives primarily as partial remains of the east and west courtyards on the north side, divided by a two-story gatehouse on North Street (Figure 8). The north gatehouse measures 7.7 m by 4.5 m, and the main opening is approximately 3.34 m wide and 4.0 m high, indicating a street-oriented entrance that supported movement of goods and people.

Figure 8. Current Status of the Gate House (Source: Photographed by the author)

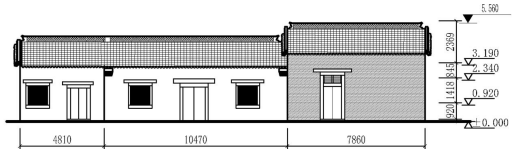
In the eastern yard, the north-side building retains five bays with a total frontage of about 23 m, and the central bays have been adapted as street-facing shops, maintaining the commercial–residential linkage typical of a shop–courtyard compound. Key surviving spaces include a daozuo room block measuring 7.1 m by 3.6 m, while the former storage and service buildings in the south and east sides have largely collapsed or been rebuilt (Figure 9).



(a) Elevation of the West Courtyard Gate



(b) Elevation of the Reversely-set Room of the West Courtyard



(c) North Elevation of the West Courtyard Wing Room

Figure 9. Elevations of the West Courtyard (Source: Drawn by the Author)

Across the street, only a two-story three-bay building remains in the west yard. Documentary records indicate that a former four-bay west building measured about 13 m by 5 m with a height of approximately 9 m, combining family gathering spaces on the ground floor with an upper-level embroidery loft. This arrangement reflects the integration of domestic life with production and household management typical of merchant compounds (Figure 10).

The southern yard formed the main production zone, with workshops (carpentry, oil processing, and distilling) and a well arranged along the passage, together with storage rooms and workers' dormitories. Ancillary facilities outside the compound, totaling about 8 mu (approximately 0.53 ha), supported drying, cultivation, and livestock, while the north–south gates could be closed to enhance enclosure and security.

Figure 10. East-Yard Building (Source: Photographed by the Author)

3.4 Official-and-Gentry Residence: Du Shoutian Residence

Du Shoutian Residence is located on Nanjie Street, Binbei Subdistrict, Bincheng District, Binzhou, Shandong Province. It is a historic architectural complex that exhibits representative folk-building characteristics of northern Shandong from the Ming and Qing periods. The residence was first built in the Ming dynasty under the direction of Du Shi, the eighth-generation ancestor of Du Shoutian and a Provincial Administration Commissioner of Jiangxi. It later served as the place where Du

Shoutian lived and studied from birth through his youth.

The complex originally covered about 25 mu (approximately 1.67 ha) and comprised 28 courtyards and more than 300 rooms. Its principal buildings included main halls, an embroidery loft, wing rooms, and an ancestral hall. The extant remains mainly consist of the embroidery loft, a reception hall, and parts of the main halls, and the overall style is restrained and plain. Although Du Shoutian rose to first-rank official status, the residence was not expanded into a high-walled, deep-courtyard compound. Instead, it is expressed through the modest regulation of a three-bay principal room with a five-frame beam system. Decorative carving and painting on beams and columns are rare, indicating the Du family ethos of integrity and upright conduct. After conservation and restoration, parts of the site were opened to the public in 2010. In 2013, it was approved by the People's Government of Shandong Province as a provincial-level protected cultural relic site.

The courtyard layout of Du Shoutian Residence is orderly and its functional system is complete. The family's principal residential area comprises multiple courtyard groups, including the Main Courtyard, Taikang Di, and Rongde Tang, which served as daily living spaces for different branches of the family. The embroidery loft, built in the mid-Ming period, is a landmark structure of the residence. It is a two-story brick-and-timber building, with living rooms on the ground floor and dedicated spaces for qin, chess, calligraphy, and painting on the upper floor, indicating the family's emphasis on equal educational access for men and women. Jingming Shanfang, also known as the Xixuan Study, is located in the educational core area and functions as an important carrier of the family's scholarly lineage. Its U-shaped stele corridor is engraved with admonitory excerpts from Shuxun, and Du E and Du Shoutian studied there. Supporting facilities are well integrated. Zhongxiao Tang (also called Baishi Fang) served as a council hall for clan affairs such as genealogy compilation and public welfare. Hanlin Tang is decorated with brick carvings of the Sanyang Kaitai motif and was specifically used to receive officials and host literary gatherings. In addition, the commercial space of Datong Guesthouse and the ancestral hall for ancestor veneration together formed a settlement system that integrates social interaction with ritual-based moral instruction. [7]

The extant buildings mainly use gabbled roofs and juanpeng roofs. After restoration, the principal courtyards have largely recovered their Ming–Qing appearance.

Du Shoutian Residence faces south and has gates opened to the east, south, west, and north. The courtyards form a typical northern courtyard-based architectural complex and adopt a linked "Eight Major Courtyards" layout characterized by openness and connectivity. Courtyard groups are interconnected through gates, passages, and corridor-like verandas, producing a configuration in which spaces remain independent while households remain mutually accessible. This arrangement both protects the privacy of family branches and, through physical connectivity, conveys the idea of household harmony. The courtyard known as Gangzhuzi, retained in the southwest corner and associated with a resident household of the Gang surname, provides a distinctive witness to this layout and highlights the Du family ethos of uprightness and benevolence.

The core buildings follow a regulated scheme of one gate with a three-bay principal room and a five-frame beam system. Although Ming ritual regulations would have permitted a larger scheme, the Du family consistently maintained a low-profile approach and did not exceed the prescribed limits. The Main Courtyard, built by Du Shi during the Wanli reign of the Ming dynasty, covers 1.04 mu and is located on the west side of the residence, serving as the central courtyard of the overall complex. Hanlin Tang is placed in front and forms a separate courtyard. Its entrance is a floral-pendant gate, and the front yard ground is paved with brick and stone. The courtyard has a frontage width of 15 m and a depth of 9 m. The building is brick-and-timber in structure, with a frontage width of 10.4 m, a depth of 5.37 m, and a height of 4.5 m. Three steps are set in front of the entrance. Doors and windows adopt an integrated combination of lattice-panel doors and ornamental-lattice windows. Passing through Hanlin Tang leads directly into the Main Courtyard (Figure 11).

The Main Courtyard is enclosed by the Xixuan Study, the east wing room, and the principal room. The Xixuan Study and the east wing room strictly follow the Qing-dynasty regulation that the central bay is privileged and the secondary bays are symmetrical. The central bay uses lattice-panel doors as the main entrance, and the

secondary bays on both sides are fitted with ornamental-lattice windows of equal dimensions. Both the plan and the elevation are symmetrical along the central axis, and the wing-room plan presents a concave form. The wing room has a frontage width of 8.6 m and a depth of 4.6 m. The central-bay doorway is 1.54 m wide and 2.42 m high, and the ornamental-lattice windows in the secondary bays have a full height of 2.72 m.

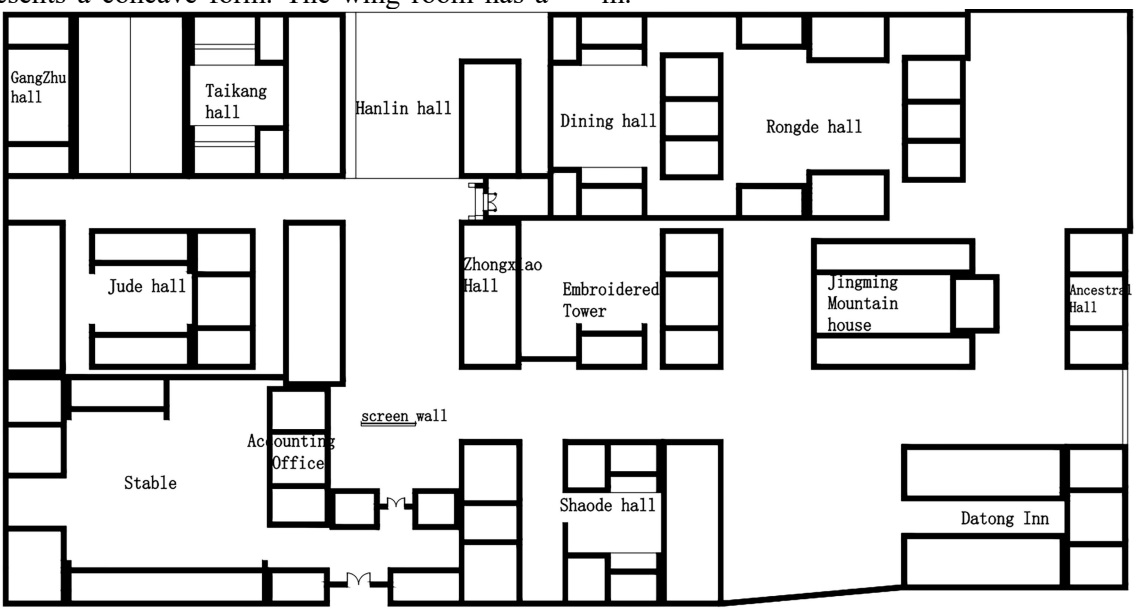
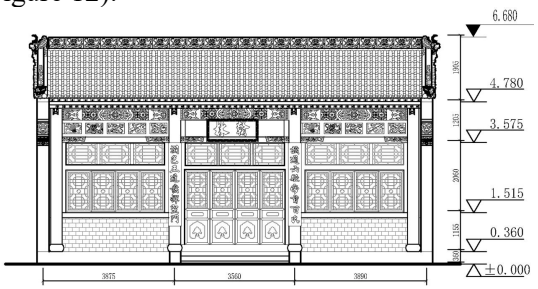
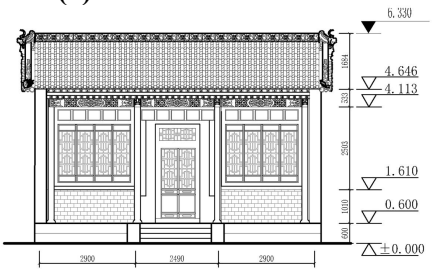


Figure 11. Floor Plan of the Residence
(Source: Drawn by the Author)

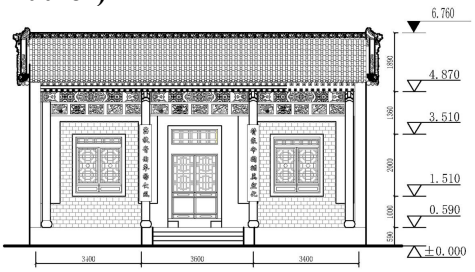
The principal room on the north side is arranged in three bays. Four steps are placed in front, and the platform is 0.45 m high. Each tread is 0.31 m wide and each riser is 0.16 m high. The building has an overall frontage width of 10.31 m and a depth of 5.46 m. The central-bay doorway is 1.73 m wide and 2.81 m high, which is noticeably larger than the doorways of the secondary bays, further reinforcing the primary–secondary spatial order and its ritual expression (Figure 12).



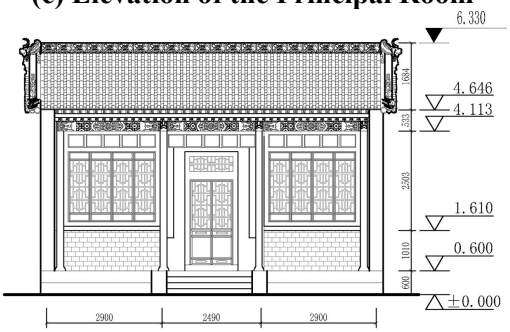
(a) Elevation of Hanlin Hall



(b) Elevation of the West Wing Room



(c) Elevation of the Principal Room



(d) Elevation of the East Wing Room

Figure 12. Elevations of the Residence
(Source: Drawn by the Author)

The decorative program of Du Shoutian Residence is characteristically restrained and avoids ostentation, aligning with gentry ideals of moral cultivation and disciplined conduct. Entering from the east gate, the screen wall forms the primary visual focus, using a birds-with-scrolling-foliage motif executed with clear hierarchy and limited repetition. In the

educational core, Jingming Shanfang is framed by a U-shaped stele corridor engraved with maxims from Shuxun, translating moral instruction into a durable spatial and material form. Elsewhere, decoration is selectively applied to reinforce function and status, including plain treatment at Zhongxiao Tang and the Sanyang Kaitai brick-carving motif at Hanlin Tang as a formal, auspicious emblem within a controlled visual order.

4. Comparative Analysis of Traditional Dwelling Types

Building on the four case studies above, this section synthesizes typological differences across plan layout, settlement siting, and decorative style.

Typological comparison informs conservation priorities and intervention boundaries. Studies in Shandong advocate graded protection and coordinated participation among government, professionals, and local communities, while maintaining settlement character and avoiding homogenized imitation. [8] Laser scanning and photogrammetry are recommended to support systematic recording, archiving, and long-term management of surviving fabric. [9]

In traditional dwellings, the spatial configuration of multi-bay courtyard compounds is often closely associated with lineage-based co-residence. This layout accommodates the needs of shared economic activities, such as cooperative agricultural production and household-based handicraft operations, while embedding family ethical concepts within spatial order. It indicates a traditional Chinese social structure that is organized around kinship ties, regulated by ritual norms, and characterized by the isomorphism between family and state, together with its underlying humanistic values. [10]

4.1 Plan Layout of the Dwellings

(1) Lineage-based clustered traditional dwellings. The layout is typically compact and habitation-centered, with courtyard spaces organized to support multi-household co-residence and everyday cooperation. In the Zhao Family Architectural Complex, most spaces primarily serve domestic use, while functional zoning and a primary–secondary order help maintain ethical norms within shared living.

(2) Defensive-facility traditional dwellings. The layout prioritizes enclosure and controlled access, producing inward-oriented courtyard groups with reinforced perimeter elements. The Wang Family Courtyard shows block-like massing, with defensive components placed around residential spaces and an internal underground passage that extends protection into a vertical defense system.

(3) Merchant residential compound–type traditional settlements. The plan combines a street-facing commercial interface with an inward domestic core. Quanshun Courtyard is built adjacent to the street, where shopfront openings support display and customer circulation, while rear connections link business operation, storage, and living spaces through the courtyard.

(4) Official-and-gentry residence–type traditional settlements. The plan is governed by status hierarchy and ritual order, commonly using axial symmetry, front-hall and rear-residential sequencing, and a controlled gate system. In Du Shoutian Residence, an ancestral hall and a family school are integrated to support ritual practice and education, and dedicated halls and guest rooms provide formal reception spaces within a clear inner–outer zoning framework.

4.2 Settlement Location

Lineage-based clustered settlements are commonly embedded in pre-existing villages, where compounds expand incrementally from ancestral properties and remain closely tied to everyday agricultural life. The Zhao Family Architectural Complex grew through intergenerational extension from an earlier courtyard, producing a stable and inward-oriented residential setting shaped by long-term co-residence. [11]

Defensive-facility settlements often incorporate strategic siting principles, yet in plains or low-hill areas defense may depend primarily on constructed systems rather than terrain. The Wang Family Courtyard remained within the original village substrate and achieved defense-oriented reinforcement through added perimeter elements and controlled circulation, including high walls, blockhouses, watchtowers, and underground passages.

Merchant residential compound–type settlements emphasize accessibility and market proximity, typically presenting a street-oriented frontage with domestic space organized behind the commercial interface. Quanshun Courtyard, as a street-front shop–residence compound on a main

road, increased visibility and operational convenience by directly facing passing trade and local customers. [7]

Official-and-gentry residences are commonly associated with prominent or central town locations, but their actual siting is often conditioned by inherited land and surrounding fabric. Du Shoutian Residence was expanded from an ancestral home under strong constraints from adjacent dwellings, and the retention of Gangzhuzi at the southwest corner records this site limitation.

4.3 Decorative Style

Lineage-based clustered dwellings typically adopt restrained decoration with concentrated themes and simplified forms. Motifs largely focus on continuity and household prosperity, and recurring patterns such as scrolling-vine and meander motifs are used with controlled color application. This restraint aligns with lineage values that emphasize ethical order and internal continuity rather than outward display.

In defensive-facility and merchant residential compound–type settlements, decoration more frequently employs plant-based subjects and conventional auspicious themes, reflecting pragmatic wishes for safety and prosperity. Motifs are differentiated by location and function, with ornament commonly concentrated at entrances, window lattices, and under the eaves. This produces a more varied repertoire than lineage-based dwellings and links symbolic expression to needs of defense or commerce.

Official-and-gentry residences present the most diverse decorative repertoire, combining plants, auspicious animals, objects, and scholar's studio implements within a coherent symbolic system. In addition to secular wishes for good fortune and longevity, motifs such as plum, orchid, bamboo, and chrysanthemum and themes of qin, chess, calligraphy, and painting convey gentry ideals of self-cultivation and refined conduct.

5. Conclusion

This study examines representative traditional dwelling types in Zibo, Binzhou, and Dongying in the lower reaches of the Yellow River in Shandong through case-based comparison. Across the four categories, the findings indicate that spatial organization consistently aligns with dominant social functions and corresponding symbolic systems. Lineage-based clustered dwellings prioritize compact courtyard layouts that support co-residence and everyday cooperation, with restrained decorative programs that emphasize continuity and ethical order. Defensive-facility compounds strengthen enclosure and spatial control through layered protective elements and internal circulation strategies, forming an integrated defense-oriented system. Merchant residential compounds reorganize the courtyard model to accommodate street-facing commercial interfaces while maintaining an inward domestic core, achieving functional hybridity between business operation and habitation. Official-and-gentry residences exhibit the strongest hierarchical ordering through axial symmetry, front–back sequencing, and dedicated ritual and educational spaces, with decorative repertoires that integrate status representation and literati ideals. These typological differences demonstrate how vernacular construction in this region materializes adaptive responses to environment, economy, and social structure. The remaining buildings constitute valuable evidence for architectural history and regional cultural studies, and they should be conserved through documentation, condition assessment, and context-sensitive management to support long-term protection and transmission.

Acknowledgments

This Study is supported by: Major Project of the National Social Science Foundation of China "Historical Collation and Research of Cultural Exchanges Between Chinese and Foreign Craftsmen Along The Silk Road" (Approval No.: 22&ZD227); the Planning Project of Shaanxi Art Institute "Research on National Cultural Park Design" (Project No.: YG2025001).

References

[1] Jiao, L. Research on the Renewal strategy of traditional dwellings in the Central Shandong under the background of rural revitalization. Jinan: Shandong Jianzhu University, 2024.

[2] Liu, Y. Spatial form types and water adaptation strategies of typical villages in the Yellow River Delta. Jinan: Shandong Jianzhu University, 2021.

[3] Li, Z. Shandong Traditional referential village. Beijing: China Forestry Publishing House, 2018.

[4] Pan, H., Su, W., Wang, W., et al. Analysis to the Main Categories and Architectural

Features of Traditional Shandong Folk House. Housing Science, 2023,43(10):30-34+63.

[5] Zibo Municipal Committee of the Chinese People's Political Consultative Conference. Zibo memory of villages (Volume 1). Jinan: Shandong People's Publishing House, 2017.

[6] Ling, J. W. Research on contemporary courtyard design under the influence of traditional Chinese spatial imagery. Shenyang: Shenyang Jianzhu University, 2016.

[7] Zhang, M., Wang, S. F. Imperial teacher and the former residence of Du Shoutian. Shandong Archives, 2012(5): 66-68.

[8] Liu, C., Zheng, Z., Kang, Z. Analysis of Construction Characteristics and Conservation Measures of Traditional Dwellings in Southern Shandong: A Case Study of Zhucun Village, Linshu County. Real Estate World,2024,(12):25-28.

[9] Qi, Z. Research on the characteristics of traditional residential buildings in the Lunan region and strategies for their conservation and development. Qingdao: Qingdao University of Technology, 2023.

[10] Sun, D. Z. Research on Chinese vernacular dwellings. Beijing: China Architecture & Building Press, 2004.

[11] Wang, Y. Spatial concepts in the structure of traditional settlements. 2nd ed. Beijing: China Architecture & Building Press, 2016.

