ANALYSIS OF THE CULTURAL VALUE OF GENERAL RURAL RESIDENTIAL COURTYARD SPACE LAYOUT IN ZHUMADIAN

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ARTICLE HISTORY
Received: 3 February 2025 **Revised:** 17 February 2025 **Published:** 11 March 2025

ABSTRACT

With the development of modernization, the courtyard space of rural houses is facing the conflict and challenge between traditional culture and modern lifestyle. The purpose of this study is to explore the cultural value of the spatial layout of rural residential courtyards in Zhumadian area, and to analyze its importance in historical evolution, social structure and cultural identity. Through field research and literature analysis, this study first reviews the development history of rural dwellings in Zhumadian area, and reveals the types and morphological characteristics of courtyard space. Secondly, the study explores how the spatial layout of the courtyard reflects the local culture, beliefs and lifestyles, and emphasizes its role in shaping the cultural identity and sense of belonging of the villagers. Finally, based on the theory of cultural memory, this paper puts forward suggestions for the inheritance and renovation design of rural residential courtyard space, in order to meet the needs of modern life while preserving and strengthening the cultural memory of the region. The results show that the rational layout and design of courtyard space can effectively promote rural revitalization and cultural inheritance, enhance community cohesion, and improve the quality of life of villagers.

Keywords: Zhumadian Area, Rural Dwellings, Courtyard Space, Cultural Values, Cultural Memory

CITATION INFORMATION: Li, Y., Inkuer, A., & Rattanapornpisit, S. (2025). Analysis of the Cultural Value of General Rural Residential Courtyard Space Layout in Zhumadian. *Procedia of Multidisciplinary Research, 3*(3), 48.

INTRODUCTION

With the acceleration of modernization, the courtyard space of rural houses in Zhumadian area is facing the conflict between traditional culture and modern lifestyle. According to the data of the "2023 Statistical Communiqué on the National Economic and Social Development of Zhumadian City", the urbanization rate of Zhumadian has increased by 14% compared with 2010, and 23% of the courtyards of traditional houses in natural villages have been abandoned or rebuilt in the past five years, resulting in the accelerated disappearance of agricultural cultural symbols and folk culture. According to the statistics of the Blue Book of Rural Revitalization in Henan Province (2022), from 2015 to 2020, the proportion of reinforced concrete structures in new residential buildings increased from 47% to 83%, and the number of traditional brick and wood structure houses decreased by 12% per year, intensifying homogenization. According to a 2021 survey by the Ministry of Housing and Urban-Rural Development, 79% of residential courtyard space has been compressed to less than 50 square meters, and the function has shifted to parking, debris stacking, etc., and the retention rate of traditional farming cultural symbols is less than 17%.

In addition, the cultural ecology of rural residential courtyard spaces has also suffered a double impact, with the Zhumadian Municipal Bureau of Culture and Tourism conducting a 2023 sample survey finding that only 28% of villagers under the age of 35 can fully participate in the Spring Festival ancestor worship ceremony, and the family reunion rate during the Mid-Autumn Festival has dropped to 53%.

At the same time, industrialized agriculture's erosion of agricultural civilization severely affects the rural ecological environment. The application of chemical fertilizers in Zhumadian's arable land far exceeds the national average. According to the Cultivated Land Quality Monitoring Report released by the Zhumadian Municipal Bureau of Agriculture and Rural Affairs in 2023, agricultural non-point source pollution accounts for 61% of the region's total pollution, directly threatening food security.

These data show that Zhumadian is not an isolated case. According to data from China's Ministry of Housing and Urban-Rural Development, the number of traditional villages in the country has plummeted, with less than 8% of existing villages intact in the cultural space of residential courtyards (White Paper on China's Rural Architectural Heritage, 2023). In the face of such a severe situation, this study focuses on two core issues: how to achieve a balance between the regeneration of traditional courtyard functions and cultural survival in the process of rural economic modernization, and how to transform the intangible cultural value carried by courtyards into resources for modern community governance and cultural tourism development.

Research Objectives

To study the cultural memory in Zhumadian’s residential courtyard layouts and develop design strategies that balance heritage preservation with modern living needs.

LITERATURE REVIEWS

The History and Evolution of Residential Courtyards in the Zhumadian Area

Zhumadian City, located in the southeast of Henan Province, boasts a long history and rich cultural heritage. As a typical representative of Central Plains agricultural civilization, its history dates back to prehistoric times. The discovery of the Peiligang cultural site proves that this area is one of the origins of Chinese civilization. Since the Zhou Dynasty, Zhumadian has been a crossroads of politics, economy, and culture, evolving from the fiefdom of the Cai State in the Zhou Dynasty to a strategic transportation hub in the Qin and Han Dynasties, an agricultural center in the Tang, Song, and Yuan Dynasties, and a commercial hub in the Ming and Qing Dynasties. In modern times, it became a center of revolutionary activities and, after the reform and opening-up, developed into an important economic and cultural hub in Henan

Province. However, due to historical wars, natural disasters, and modernization, traditional residences have been severely damaged, with most existing buildings reconstructed after 1976, and less than 10% of villages retaining their historical appearance.

The spatial form of rural residential courtyards in the Zhumadian area reflects the adaptability of Central Plains agricultural civilization. The Peiligang cultural site already shows early settlement prototypes, and the courtyard style in southern Henan gradually matured, exhibiting a unique "narrow courtyard with deep eaves" appearance. However, modernization has posed challenges of alienation to traditional courtyards. According to the Survey Report on Traditional Villages in Henan Province (2021 edition), traditional residential courtyards currently account for only 9.7% of rural housing in the area, with agricultural cultural symbol retention rates below 12%. This significant change aptly confirms the phenomenon of "constructive destruction" proposed by Wu Liangyong, where the process of material renewal and transformation often accompanies the rupture and loss of cultural memory.

Analysis of the value of courtyard space from the perspective of cultural memory theory

The theory of cultural memory (Jan, 1995) provides a key framework for interpreting the mechanisms of cultural survival in courtyard spaces. Traditional Chinese courtyards realize the intergenerational transmission of collective memory through the dual coding of material carriers (Such as the orientation of the ancestral hall, the height of the threshold, the storage of granary and agricultural tools, the location of the kitchen and bathroom) and the ritual practice (Such as ancestor worship, harvest celebration, and wedding ceremony). The pastoral imagery of "more than ten acres of square houses and eight or nine thatched houses" in Tao Yuanming's "Returning to the Garden" and Wang Guowei's interpretation of the realm of "a little deeper in the courtyard" in "Words of the World" all reveal the poetic construction of the courtyard as a "memory field". Liang Sicheng further pointed out in "Beijing City: History and Present Situation" that the cultural memory value of architectural space lies not only in the existence of form, but also in the "dynamic inheritance" through functional activation. This concept has been verified in contemporary practice: Wang Shu's Wencun renovation project has increased the villagers' cultural identity from 52% to 79% by retaining the stone low wall (81% retention rate of cultural symbols) and embedding the function of the tea room (63% replacement rate) (Wang, 2017), which provides a methodological reference for renovation of Zhumadian courtyard: it is necessary to balance the survival of material symbols and regeneration and transformation of functions.

The spatial crisis of rural courtyards and academic responses under the impact of modernization

1) The impact of urbanization and industrialization on the rural courtyard of Zhumadian presents the following three-dimensional characteristics:

Material homogenization, with village characteristics disappearing and a high proportion of standardized housing types in new constructions, leading to a low retention rate of regional symbols; Ecological efficiency degradation, with minimal use of local materials in new residences and increased energy consumption (Li, 2022); Social relationship alienation, with severe hollowing out of rural villages, causing courtyards to degrade from social centers to "seasonal containers," and a decline in community cohesion (Henan Province Rural Social Survey, 2023).

2) In response to the above crisis, two types of targeting strategies are proposed:

Conservation paradigm: For example, the UNESCO Living Heritage Guidelines emphasize "community participation", but only 28.7% of villagers in the existing conservation plan in Zhumadian consider them to "respect living habits" (Li, 2022);

Updating the paradigm: Zhou Lijun's "Research on the Form of Traditional Chinese Folk Houses" proposes "functional replacement guidelines", but lacks quantitative grading tools for cultural memory elements (such as symbol retention priority).

Academic research gaps and the theoretical framework of this study

1) There are three limitations in existing research:

Spatial scale deviation: the macro protection plan ignores the "cultural-ecological-social" composite attribute of the courtyard micro space;

Lack of subjectivity: The existing evaluation model relies on the perspective of experts and ignores the subjective cognition of villagers. Li Jianhua et al. (2022) conducted a survey of traditional villages in Henan Province, showing that only 28.7% of villagers believe that the conservation plan 'respects living habits', while in the 2023 rural housing renovation project in Zhumadian City, 34% of the courtyards were rebuilt by the villagers themselves due to lack of practicality (Zhumadian Housing and Urban-Rural Development Bureau, 2023), highlighting the gap between expert decision-making and people's needs. ”

Lack of strategic tools: The existing guidelines mostly focus on material preservation, and lack a coupling model of "memory elements and functional needs".

2) This study intends to innovatively construct a "design framework for courtyard renewal and renovation from the perspective of cultural memory":

Theoretical level: Integrating Assmann's cultural memory theory and Fei Xiaotong's analysis of the social structure of "Rural China", the three-dimensional interaction mechanism of "space-ritual-identity" is proposed.

Methodological level: Based on the fieldwork in Zhumadian, a "memory element map" was established (including quantitative indicators such as the weight of the ancestral hall axis and the retention of farming symbols).

At the practical level, a "hierarchical update strategy" was formulated (such as mandatory retention of symbols in the core area and functional compatibility in the transition area), and the acceptance of the scheme was improved through participatory design by villagers (target satisfaction ≥ 65%).

RESEARCH METHODOLOGY

In this study, we used mixed methods to reveal the spatial representation mechanism of cultural memory through qualitative analysis, and combined with quantitative data to verify the feasibility of the strategy, the specific framework is as follows:

Based on Jan Assmann's cultural memory theory as the analytical framework, the three-dimensional analysis model of "space-memory-function" is constructed from the perspective of Fei Xiaotong's "rural China" social structure. Following the logical chain of "historical traceability→ current diagnosis→ value evaluation →strategy generation", the explanatory sequence design (qualitative→ quantitative → qualitative) was adopted.

Qualitative stage: identification of cultural memory carriers through literature analysis and fieldwork; Quantitative stage: Questionnaire and spatial measurement data were used to verify the weights of memory elements; Integration stage: Optimize the renewal strategy based on villager participatory design.

Data Collection

1) Sample Selection：For the general villages in this study, three representative villages were selected, namely Caozhuang Village (65% hollowing rate), Hongshiya Village (45% preservation rate of brick and wood structure dwellings) and Linzidi Village (7% preservation rate of brick and wood structure dwellings). At the same time, 30 residential courtyards were selected for spatial observation, and the four types of people were interviewed by combining purposive sampling and snowball sampling.

Table 1 Interview Group Sampling Table

Number of People	Selection Criteria
6	Continuous residence ≥ 40 years, familiar with traditional customs
12	Family decision-makers, willing to renovate
3	In office ≥ 5 years, familiar with village changes
3	In the field of cultural heritage/architectural planning

2) Literature Analysis: Through interpreting historical documents including Zhumadian City Chronicles, Zhumadian Past and Present, and Henan Traditional Architectural Atlas, this study traces the evolution of courtyard typologies from the Ming-Qing dynasties to contemporary era. By analyzing government policy documents, it examines how rural housing renovation clauses impact cultural memory preservation.

3) Field Investigation: Spatial mapping was conducted to obtain courtyard models. Photographic documentation and architectural symbol sketches were created to represent courtyard cultural elements. A "Residential Courtyard Space Observation Form" was developed, with 30 cases observed in this study. An "Courtyard Usage Behavior Observation Form" was designed to record temporal-spatial distributions of 10 key activities (e.g., dining, farming, drying crops, ancestor worship, social visits), covering both daily routines and Spring Festival customs (individual recordings, not representing collective patterns).

4) In-depth Interviews: Semi-structured interviews were organized around three dimensions: "memory anchor identification - functional demand conflicts - renovation willingness". Sample questions included: "Which courtyard elements best represent your village's historical culture?" (memory anchors) and "What aspects of current courtyards cause inconvenience?" (functional conflicts). Semantic network analysis will be applied to extract high-frequency keywords from interview transcripts.

5) Questionnaire Survey: Scale Design: Based on cultural memory theory, five latent variables (historical identity, functional adaptation, ecological perception, social satisfaction, and renovation willingness) were constructed, comprising 23 items using a 5-point Likert scale. After passing validity tests, 360 questionnaires were distributed, achieving a valid response rate of 91.4% (N=329).

Table 2 Scale design

Latent variables	Examples of observed variables	Number of items
Historical identity	“The Importance of the Ancestral Hall's Orientation to Family Unity”	5
Functional adaptation	“Will the existing yard meet the parking needs?”	4
Ecological perception	“Rammed earth walls are more environmentally friendly than concrete”	3
Social satisfaction	“Is the patio easy to chat with the neighbors”	5
Renovation willingness	“Are you willing to sacrifice space for the preservation of traditional symbols?”	6

6) Case Studies: Comparative analysis was conducted on three domestic cases including Zhejiang’s "Wencun Model" and Anhui’s "Bishan Project", extracting transferable strategies for balancing "memory-function" adaptation.

Data analysis

Qualitative Analysis: Through thematic analysis, a three-tier coding system for courtyard cultural memory was identified (e.g., "Tier 1: Material Carriers → Tier 2: Ancestral Hall → Tier 3: Orientation Taboos").

Quantitative Data: Chi-square tests conducted via SPSS 26 verified correlations between "cultural symbol retention rates" and "villagers' willingness toward housing renovation" as well as "villager satisfaction." An Analytic Hierarchy Process (AHP) was applied to develop a "Cultural Memory Element Prioritization Model," with 10 experts invited to assign weights to each indicator.

RESEARCH RESULTS

Architectural Structure and Cultural Connotation of Traditional Dwellings

1) Architectural Structure and Cultural Symbolic System

Structural form: One of the major characteristics of traditional residential architecture is that the structure is exposed, and the mechanical characteristics of the structure can be intuitively seen. Most of the traditional dwellings in the Zhumadian area are mainly beam-lifting frames, which are characterized by the following characteristics: beams are placed on the columns, purlins are placed on the beams, and short beams are supported on the beams, so that the roof trusses are raised on top of each other, as shown in the figure 1. The roof ridge is centered along the longitudinal length of the house, and the front and rear slopes are drained； Set up purlins under the middle ridge, call the purlin, set up purlins on the front and rear walls, call the eaves purlin, when entering the depth, a purlin will be set up in the middle section of the two slopes again, called the fine purlin, in this way, two eaves purlins, two fine purlins, one middle purlin, a total of five purlins. When the depth of the house is larger, one purlin is added to each of the two slopes, and one uses seven purlins.

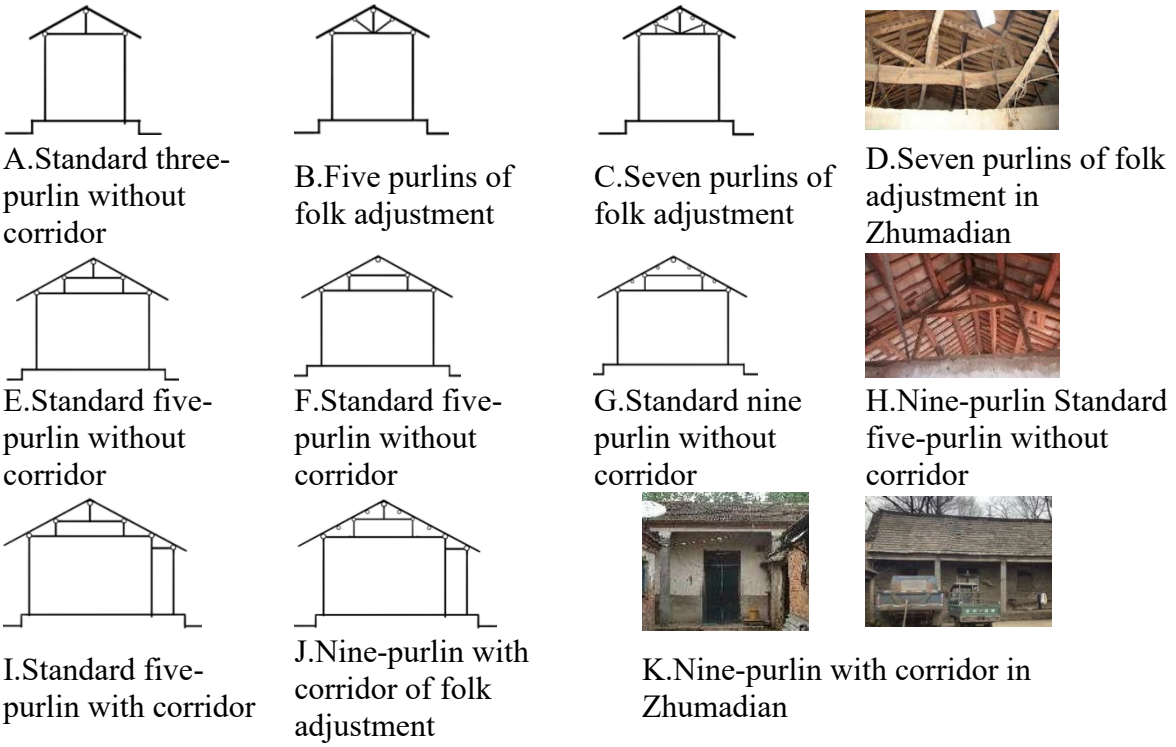


Figure 1 The section of Tailiangshi-goujia

Cultural connotation: 1) Since ancient times, odd numbers are auspicious. People commonly say: four or six do not become talented. Therefore, the number of purlins in each room of the

house cannot be an even number, reflecting the agrarian society's awe of the laws of nature and the psychology of seeking good fortune and avoiding evil. With the development of society, the span of people's houses is getting larger and larger, and even numbers such as 7, 9, and 11 per room are gradually formed. 2) The slope of the beam-lifting roof (e.g., 1:2.5) adapts to the Chinese monsoon climate, and the rainwater flows down the tile ridge, which is in line with the feng shui concept of "four rivers returning to the church", symbolizing the cohesion of wealth and energy. 3) The beam-lifting building strictly follows the axis layout, with the main house in the center leading the overall situation, and the wing rooms being symmetrically distributed, symbolizing the unity and centripetal force of the family.

2) Building Materials, Colors, and Regional Cultural Connotations

Materials: Located in the transitional zone between the Huanghuai Plain and the Funiu Mountains, Zhumadian has a warm temperate monsoon climate (average annual temperature of 14.5°C, precipitation of 900mm), with abundant stone and timber resources. The soil quality is also good, producing loess and clay, making natural stone, adobe, and bricks the primary materials for residential buildings. The building materials in this area mainly include brick, stone, wood, and adobe or rammed earth, as shown in Table 3.

Table 3 Usage of Building Materials in Residences

Material Type	**Usage Rate**	**Physical Properties**	**Cultural Memory Association (Villager Recognition Rate)**
Blue Brick	65%	Compressive strength 10MPa, thermal conductivity 0.8 W/m·K	88% ("Symbol of ancestral craftsmanship")
Rammed Earth	42%	Thermal lag time 8h, air permeability 0.5cm/s	76% ("Memory of warmth in winter and coolness in summer")
Wood	38%	Seismic performance (mortise and tenon joints dissipate energy 30% more than steel joints)	69% ("Witness to family heritage")

Colors: The colors of residential buildings are primarily the natural hues of the materials, such as blue, earth yellow, white, and red, forming a visual system of "blue bricks and gray tiles, yellow rammed earth walls, and vermilion door frames." These low-saturation tones (average brightness 45-60) harmoniously coexist with the hilly landscape of southern Henan.

Adobe | Green brick | Rough stone | Red brick | Wood beams | Wooden door | Wooden window

Figure 2 Residential construction materials

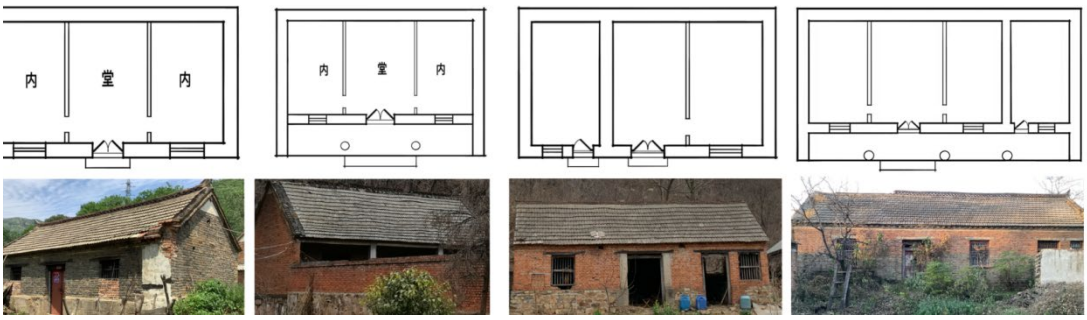
Cultural connotation: The materials are often presented in their natural colors. These natural hues blend more harmoniously with the environment, without being obtrusive, reflecting a deep respect and reverence for nature, as well as embodying the virtues of simplicity, stability, and modesty.

Blue Bricks and Tiles: Correspond to the "wood" element in the "Five Elements" (associated with the east and growth), symbolizing the hope for family prosperity.

Earth Yellow: Shares the same color scheme as the land (hue value of 45°), reinforcing the identity of "establishing a family through agriculture."
Vermilion Door Frames: A small amount of high-saturation color is used as an accent, adhering to the hierarchical norms of "not exceeding the prescribed rites" (commoners were forbidden from using pure red), while also satisfying the desire for good fortune (red is believed to ward off evil).

The layout and cultural connotation of the main single buildings of the dwellings

1) Architectural Layout Forms of Dwellings in Zhumadian
Single-building Layout Typologies: The principal buildings in Zhumadian predominantly adopt six layout forms: “One Hall, Two Inner Rooms” (Yitang ernei); “One Hall, Two Inner Rooms, One Veranda”(Yitang ernei yiyan); “Three Rooms, Two Chambers” (Sanjian liangsuo); “Five Rooms, Two Chambers” (Wujian liangsuo); “Five Rooms, Three Chambers, One Veranda” (Wujian sansuo yiyan); “Four Rooms, Two Chambers, One Veranda” (Sijian liangsuo yiyan).
Cultural connotation: This layout reflects the authority of the central hall (Mingjian), with the width of the central room accounting for 32% of the total building width (compared to 28% in a standard siheyuan), reinforcing the ritual concept of "centrality as respect." The decreasing width of rooms from left to right symbolizes the hierarchy of family seniority.

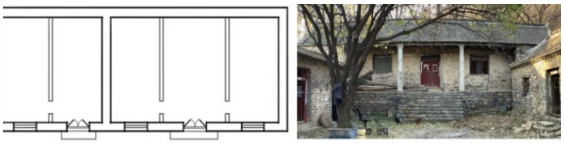


A. The basic form of “one hall and two interiors”

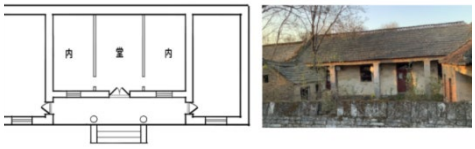
B. The basic form of “one hall and two interiors and One Veranda”

C. The basic form of “three rooms and two Chambers”

D.The basic form of “five rooms and two Chambers”



E.The basic form of“Five Rooms,Three Chambers, One Veranda”



F.The basic form of “Four Rooms, Two Chambers, One Veranda”

Figure 3 The layout form of a single residential building

2) Layout form and cultural connotation of residential courtyards
2.1) Courtyard layout form: Rural residences commonly adopt the traditional courtyard layout of the siheyuan, which can accommodate the changing needs of family members and aligns with the traditional living habits of Chinese people. A courtyard surrounded by buildings on the east, west, south and north sides is called Siheyuan. The residential style enclosed by buildings on three sides is called Sanheyuan, and similarly, the building enclosed on the north and south sides is called Erheyuan.
The courtyard of the Zhumadian rural house is based on the courtyard house, and through simplification and adaptive adjustment, a diversified courtyard layout is formed (Fig. 4). According to the fieldwork (N=30), the main types include:

Standard Siheyuan (20%): Enclosed by the main house, east and west wing rooms, and an inverted house, fully retaining the "four waters return to the hall" layout; Simplified Sanheyuan (50%): Omits the inverted house and replaces it with a wall, saving 12% of land use; Linear Erheyuan (30%): Retains only the main house and wing rooms, suitable for narrow and long plots.

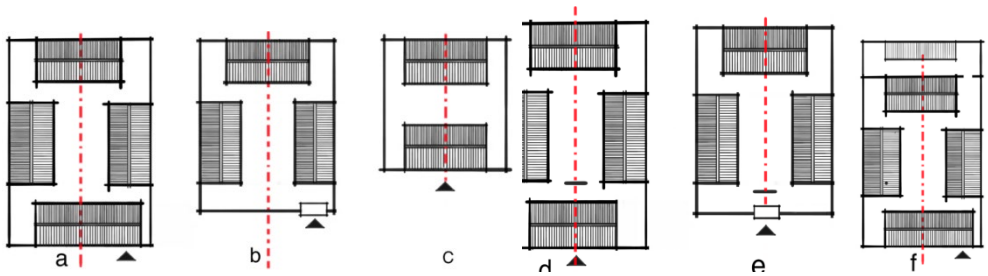


Figure 4 The layout form of the courtyard of the Zhumadian dwelling

2.2) Cultural Connotations of Functional Spaces in Courtyard Layouts

Nine Palaces Grid (Jiugongge): The overall layout of traditional siheyuan (courtyard dwellings) reflects not only natural considerations but also embodies cultural philosophies rooted in China's ancient well-field system (jingtianzhi). The well-field system, a land distribution institution during the Western Zhou Dynasty (c. 1046-771 BCE), inspired the concept of imperial city planning. Specifically, this system divided the royal capital into nine equal sectors: the palace occupied the central sector, while the remaining eight were allocated to residential wards (Lifang) and markets. This urban planning philosophy profoundly influenced the design of northern siheyuan courtyards.

This architectural principle, later termed the Jiugongge (Nine Palaces Grid), is exemplified in Figure 5. The courtyard is geometrically defined by four intersecting lines:Meridians: Formed by the front eaves of the east and west wing rooms； Parallels: Formed by the front eaves of the north main house and the inverted house.These lines divide the courtyard into nine sections, with buildings around the edges and a central courtyard.

Cultural Metaphors: The central courtyard represents "public fields," symbolizing collective responsibility; The surrounding buildings symbolize "private fields," representing family autonomy. This spatial duality metaphorically reinforces the Confucian ethic of balancing communal and individual interests (Gongsi jian'gu).

Phonetic Symbolism: The word "nine" (Jiu) sounds like "long-lasting" (Jiǔ), symbolizing hopes for enduring family prosperity and harmony.

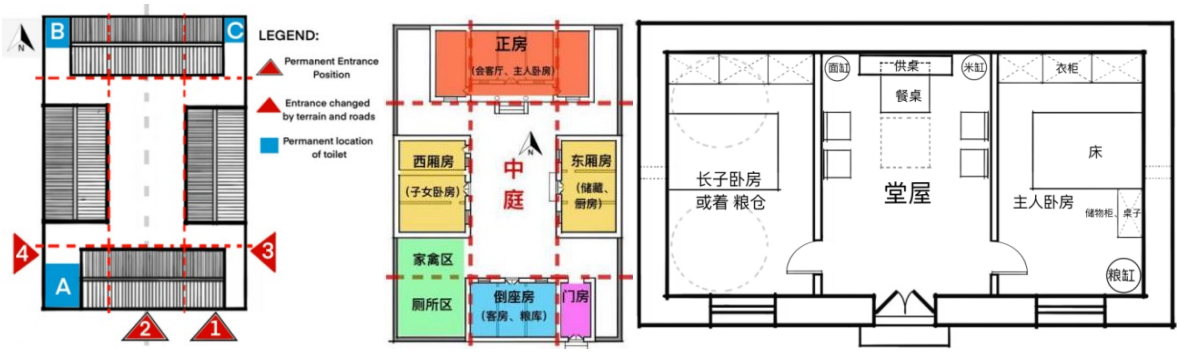


Figure 5 (1) Hidden nine grids in the layout of the courtyard (2) Courtyard interior space layout ans (3) Interior space layout of the main room

Symbolism of the Main Entrance Location: The main gate of a siheyuan is typically placed at positions 1 or 2 in Figure 5, but due to terrain or road constraints, it may also be located at positions 3 or 4. Placing the entrance in the southeast symbolizes "auspicious energy coming from the east." When the courtyard width is ≥8 meters and the main gate is at position 2, a screen wall or partition is often added to prevent straight drafts (Chuantangfeng).

Meaning of toilet location: Toilets in a siheyuan are mostly built in the southwest corner, symbolizing a bountiful harvest. In the "I Ching," Kun represents the earth. Manure serves as farm fertilizer. Accumulating fertilizer in the earth (Kun) is a sign of a good harvest. When space is limited, toilets may also be located in side rooms of the main house, outside the courtyard walls, or behind the main house. In modern times, they are often adjusted to be in a corner of the courtyard or independently set outside the walls.

Kitchen layout: The kitchen is located in the northwest high position, and the odor is discharged by using the dominant wind direction and the physical height difference.

Patio Meaning: The patio is enclosed on all sides for lighting and ventilation. The patio in the Zhumadian area, also known as the "Four Waters Returning to the Hall", Symbolizes "divine blessings raining into the home", embodying familial unity and fortune. It serves as a ceremonial space, positively correlating with family cohesion and happiness.

Courtyard plant meaning: The green area at the four corners of the courtyard will be planted with auspicious trees, such as pomegranate trees (Many sons and many blessings), begonia trees (wealthy), jujube trees (Wealth and prosperity, early birth of noble sons), etc., and some people plant locust trees (On behalf of the three princes and nine qing).

The internal spatial layout and cultural connotation of the courtyard of the dwelling

1) Internal Functional Spatial Layout of Residences in the Zhumadian Area

As shown in Figure 5 (2), the inverted house is located on the west side of the main gate and is typically used as a guest bedroom or granary. The east and west wing rooms generally consist of three or two rooms. The side room or the southern part of the east wing is used as a kitchen, while the northern part is used for storage. The west wing is usually the children's bedroom.

The main house typically consists of three or five rooms. The central room is called the "bright room" or "main hall," serving as a living room, dining room, and a place for ancestral worship. The rooms on either side are called secondary rooms, slightly smaller rooms, and end rooms, used as the master bedroom, study, and other living spaces. If the owner has an eldest son, the eastern side room of the main house is the master bedroom, and the western side room is the eldest son's bedroom, as shown in Figure 5 (3).

The north wall of the bright room usually has an altar table for ancestral tablets, with two large jars on either side for storing rice and flour for cooking. The grains in the jars are for temporary use, while most of the grain is stored in the granary, as shown in Figure 5 (3).

2) Cultural connotation

Ethical Order: The layout of "the north house is the most respected, the side rooms are secondary, and the inverted house is for guests" reflects the hierarchy within the family, indicating the relationships of seniority and status. The main house is for the elders, while the side rooms are for other family members, illustrating the family's power and respect structure.

Spiritual Beliefs: The altar table on the north wall of the main room is used for ancestral worship, embodying the spirit of remembering ancestors, reverence, and gratitude. The central hall paintings reflect the family's positive ideals and aspirations, with options like triptychs, five-panel, and seven-panel paintings, as shown in Figure 6(1).

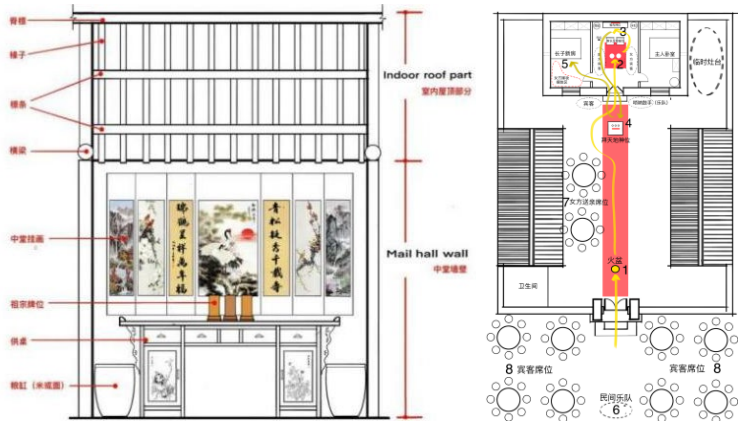


Figure 6 (1) Seven-panel central hall painting and (2) The layout of residential courtyard space during marriage

Ritual Beliefs: The festive rituals in rural Zhumadian continue Han Chinese traditions, including wedding, birth, and funeral ceremonies. Traditional marriage customs involve the "three letters and six rites," while simplified modern wedding procedures include proposal, engagement, and the wedding ceremony. Figure 6(2) shows the spatial layout of the residential courtyard during a wedding. The bride steps over a fire basin upon entering, symbolizing the dispelling of misfortune. The couple bows to the elders and worships the ancestors, expressing reverence for nature and the universe. Finally, the bride returns to the bridal chamber, and the groom entertains the guests.

Residential courtyards coexist harmoniously with animals

When people build houses, they leave special passages and living spaces for cats, dogs, birds, cows, sheep and other animals to enter and leave the house, and the natural harmony between people and animals is vividly reflected in the courtyard of the house.

Figure 7 Swallow holes, cat and dog holes in residential courtyards

There are holes for cats, dogs, chickens and ducks on both sides of the main door. When the owner closes the door, cats, dogs, chickens and ducks can enter and exit freely, as figure 7shown. There are swallow holes above the main door or on both sides of the gable. When winter turns to spring, swallows make their homes under the beams or eaves, as figure 7 shown. In traditional culture, swallows are endowed with auspicious and beautiful meanings, representing peace, reunion and happiness. At the same time, this is also the wisdom of the ancients. Field surveys show that 87% of villagers in the Zhumadian area view "empty swallow nests" as a sign of declining family fortune. The preservation rates of domestic animals in residences in this area are shown in Table 4.

Table 4 Animal preservation rate in the region, N=30

Animal Type	Passage Form	Spatial Location	Current Rate (2023)
Poultry (chickens, ducks)	Low wall openings (20×40cm)	Base of both sides of the main entrance	16%
Cats and dogs	Low wall openings (30×40cm)	Junction of wing rooms and courtyard walls	41%
Swallows	Wall openings (25×40cm)	Under the eaves or top of the gable of the main house	35%

Cultural Memory Disruption Under the Impact of Modernization

1) Disappearance of Physical Carriers: Over the past 20 years, the physical carriers of cultural elements in residential courtyards have significantly disappeared. Beam-lifted roofs have been replaced by flat roofs, natural building materials have been supplanted by industrial materials, and spaces for ancestral worship, storage areas for farming tools, swallow holes, and openings for cats and dogs have vanished in new constructions.

Table 5 Extinction of material carriers

Cultural Factors	Survival Rate of Traditional Residents (2000→2023)	Villagers' perceived importance
Ancestral Hall Sacrifice Space	92% → 34%	78%
Farm tool storage area	85% → 12%	63%
Swallow's nest / cat and dog hole	76% → 9%	82%

2) Decline of Intangible Practices: The percentage of families fully participating in the Spring Festival ancestral worship ceremonies has dropped from 89% in 2010 to 28% in 2023 (according to the Cultural and Tourism Bureau data). Among the younger generation (<35 years old), only 17% are aware of the "three letters and six rites" marriage customs, with the simplification of rituals leading to a weakened function of courtyards as ceremonial spaces.

3) Break in Craftsmanship: The average age of craftsmen capable of fully constructing siheyuan courtyards is 62, with an average of less than 0.3 apprentices trained per year. This data is sourced from the "Henan Province Traditional Building Craftsmen Status Survey Report (2022)."

4) Demand dislocation and lack of subjectivity, the existing functional space can not meet the needs of modern functions, and the proportion is relatively high,as shown in Table 5.

Table 6 Functional Conflict Quantification Table

Modern demand	**conflict rate with traditional space**	**support rate of villagers' transformation**
Motor vehicle parking	92%	68%
Private bathroom	85%	79%
Modern Kitchen Equipmen	73%	82%

(Conflict Rate = Proportion of Respondents Who Believe Existing Space Cannot Meet Demand)

A hierarchical protection model of courtyard memory elements oriented by cultural memory

Based on the AHP analytic hierarchy process, a grading strategy of "compulsory retention of core symbols, dynamic translation of secondary symbols (display wall in agricultural tool

area)-elastic replacement in variable area" was proposed, and a priority evaluation system of cultural memory elements in Zhumadian courtyard was constructed.

Table 7 Hierarchical protection model of memory elements

Element level	Indicator	Weight	Intervention strategy
Core layer	The axis of the ancestral hall Nine Palaces Grid (Jiugongge) layout	0.38	Mandatory reservation, functional compatibility
Critical layers	Farm Tool Area, Bird's Nest, Materia	0.29	Repair + Translation (e.g. Farm Tool Display Wall)
General layer	Decorative patterns, secondary ceremonial spaces	0.21	selective reproduction
Variable layers	Non-structural walls, temporary facilities	0.12	Elastic replacement

DISCUSSION & CONCLUSION

This study systematically analyzes the spatial layout of rural residential courtyards in the Zhumadian area, revealing their core value as carriers of cultural memory and their dynamic changes amid modernization. Traditional courtyards reflect agricultural ethics, family identity, and ecological wisdom, often using materials like blue bricks and rammed earth to embody the philosophy of the unity of heaven and humanity. However, the impact of modernization has led to the disappearance of traditional symbols, such as the decline in the integrity of ancestral halls and the retention rate of swallow nests. There is also a reduced enthusiasm among the younger generation for participating in traditional rituals. Additionally, the demand for modern facilities conflicts with the functional spaces of traditional courtyards, resulting in significant spatial alienation.

This study proposes a strategic framework for regenerative design: based on the theory of cultural memory, a three-dimensional interaction mechanism of "space-ritual-identity" is proposed; through fieldwork, a "memory element map" was established. Based on AHP analysis, a "hierarchical update strategy" was formulated, and the acceptance of the scheme was improved through villager participatory design (target satisfaction ≥ 65%).

Limitations of this study: The limitations of the study include the timeliness of the data and the representativeness of the sample, the historical data of 2000 rely on archives and villagers' oral accounts, there may be recall bias, and the cross-sectional study cannot track the long-term changes. 3 villages and 30 courtyards cannot represent the entire Zhumadian area.

ACKNOWLEDGMENT

Researcher would like to express her sincere to the thesis advisor, Asst. Prof. Dr. Akapong Inkuer for his invaluable help and constant encouragement throughout the course of this research. In addition, the researcher has to give thanks to all lecturers for their assistance: Asst. Prof. Dr. Chanoknart Mayusoh, and Asst. Prof. Dr. Pisit Puntien. At the same time, the researcher gratefully thanks to Miss Kanyanee Phuangsua, Miss Sasanant Rattanapornpisit, Miss Visitha Chintaladdha, Mr. Chat Sukarin, and others who give great supports.

Finally, the researcher would like to express her gratitude to the Faculty of Fine and Applied Arts, Suan Sunandha Rajabhat University for supporting in every aspect.

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Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Conflicts of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.